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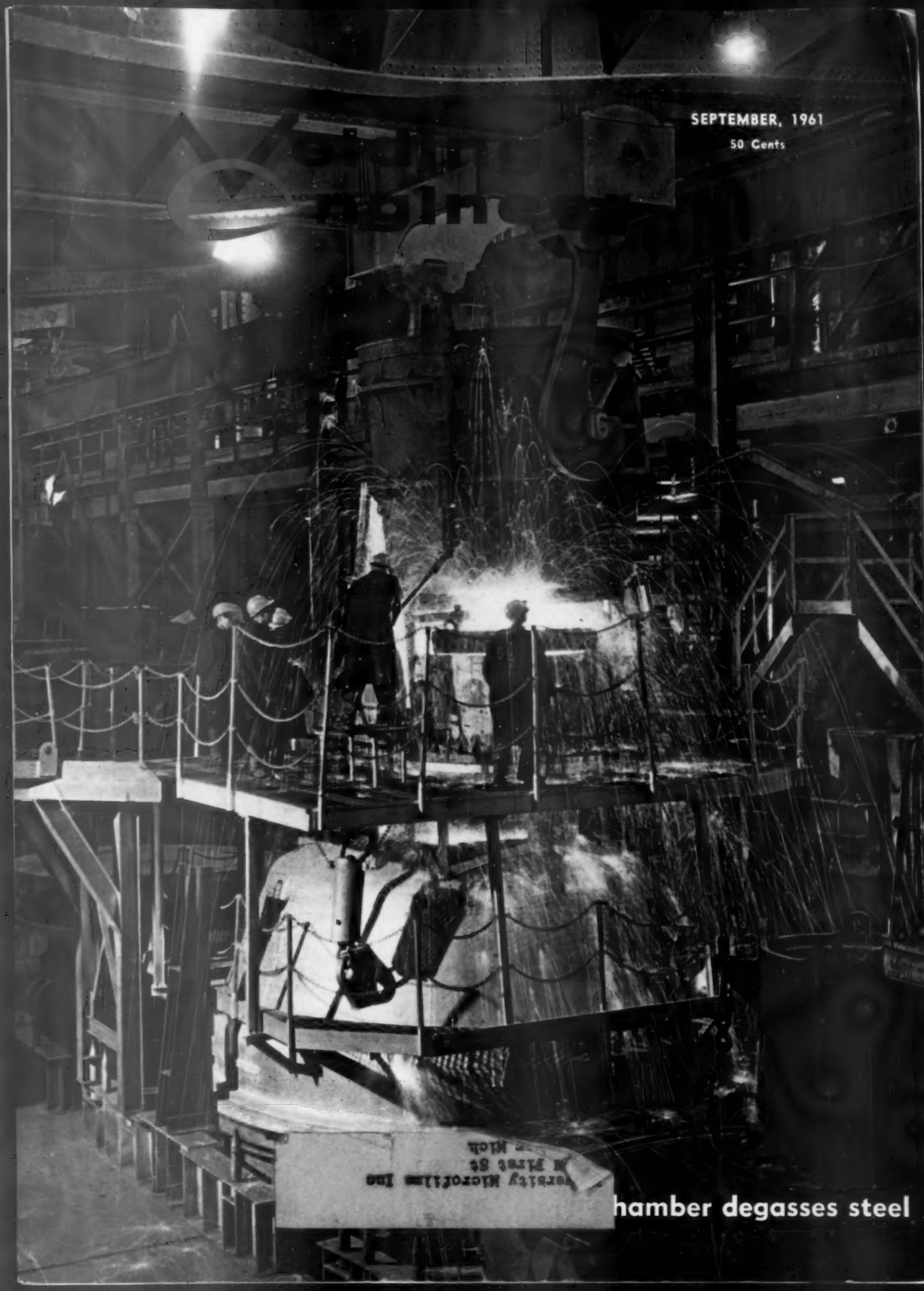
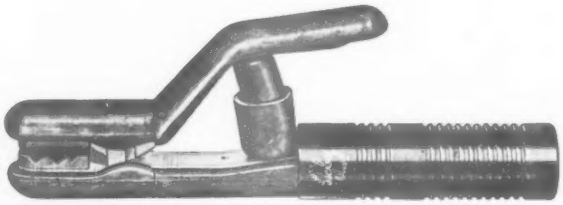


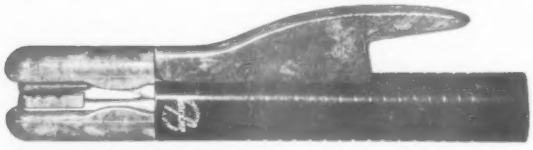
hamber degasses steel

cut welding fatigue with

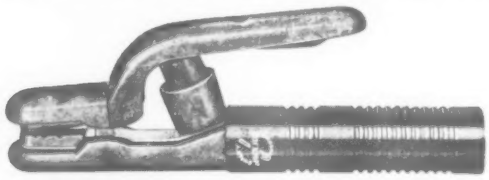
Jackson Featherlight Holders



Jackson Model A-5S, *lightest large-class holder.*
Capacity: 5/16" rods at 400 amps. (weighs only 21 oz.)



Jackson Model JH-3, *medium-class streamlined holder.*
Capacity: 1/4" rods at 300 amps. (weighs only 15¾ oz.)



Jackson Model A-W, *lightest medium-class holder.*
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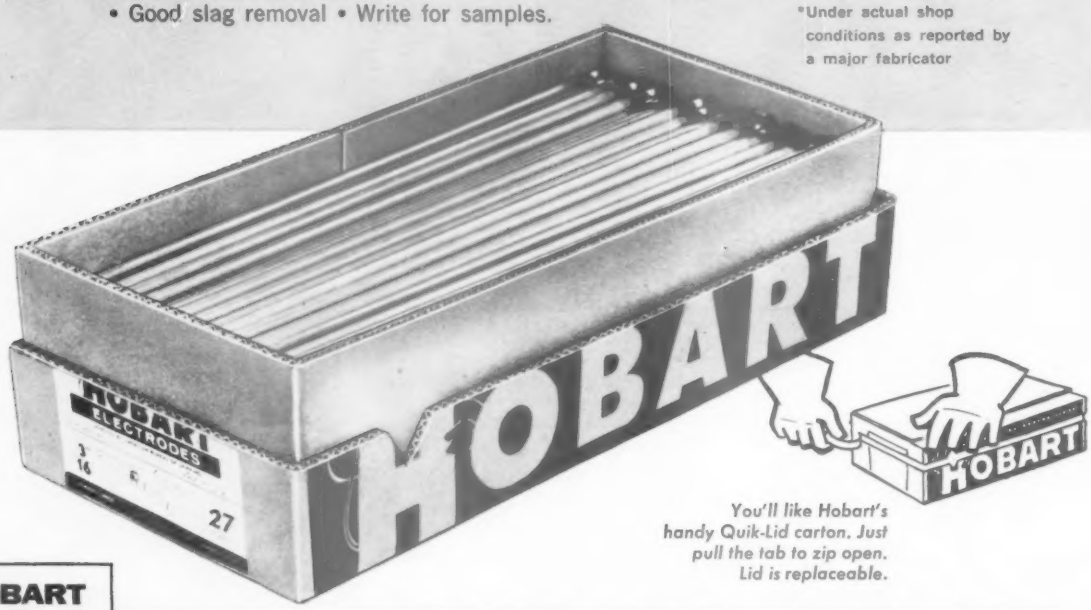

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This is welding: September, 1961

Welding Engineer

The magazine of joining and severing of materials

Cover photo . . depicts a heat of molten steel being poured into vacuum degassing chamber of welded construction; see story, page 39.

Steelmaker fabricates vacuum degassing tanks 39

Sounder, tougher and cleaner steel results when a heat of molten steel is poured into an ingot mold contained in a vacuum chamber. Editor **F. T. Tancula** reports on how one such gas-reducing tank was fabricated by the steel firm's own welding department.

Spot welding standards for galvanized steel being tested 42

Thickness variations in zinc coatings on galvanized steel cause inconsistent spot weld quality. To solve the problem, and thus help ensure the metal's continued market growth, research has begun on welding procedures and effective techniques.

★ (For a reprint of this article, circle 248 on Welding Info-Aid Card.)

Don't overlook standard shapes in your design 45

The trend in heavy equipment design is toward little open structure, little riveting or bolting, and rugged, but simple, design. Author **Rex Cleveland** details how standard shapes can be used "to do the most with the least, and yet make it look like the most."

★ (For a reprint of this article, circle 249 on Welding Info-Aid Card.)

Which water cooling system best suits your needs? 60

Higher current levels demanded of modern welding equipment can only be conducted by water cooling, since equipment size and weight are usually at a maximum already. The prime consideration then becomes selection of a cold water source, as described by **R. A. Bernard.**

★ (For a reprint of this article, circle 250 on Welding Info-Aid Card.)

Also in this issue:

Trucks out, welded pipe in for Chicago plane fueling 50

U. S. space capsule — how it was welded 59

Dallas to host AWS fall meeting; 17 sessions planned 68

Mig plus 5086 aluminum equals lightweight boats 70

Mammoth box girder supports crane runways 74

Air Force sponsors symposium on ultrasonic welding 76

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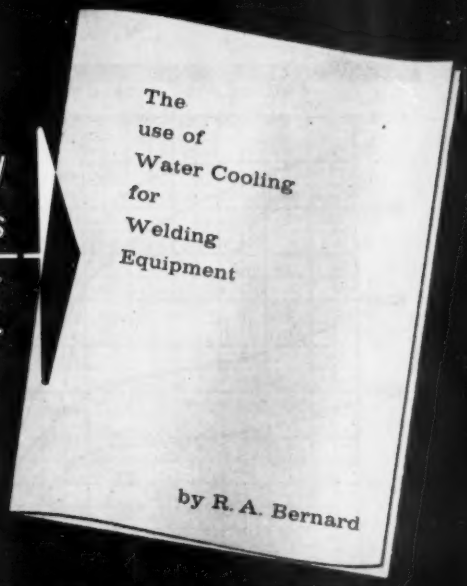

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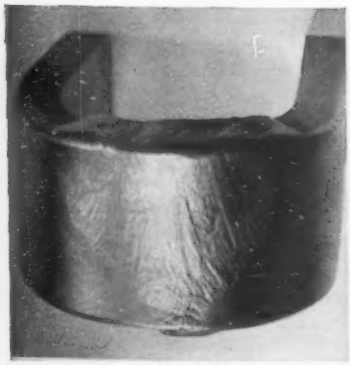
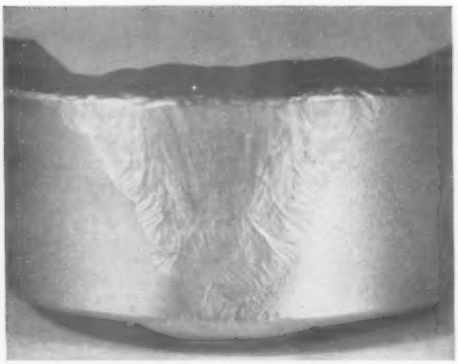
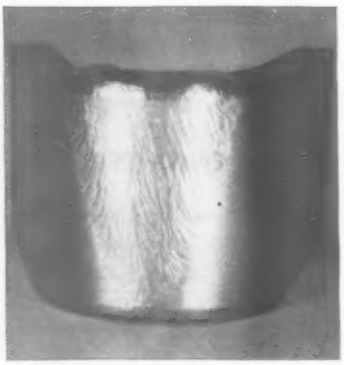


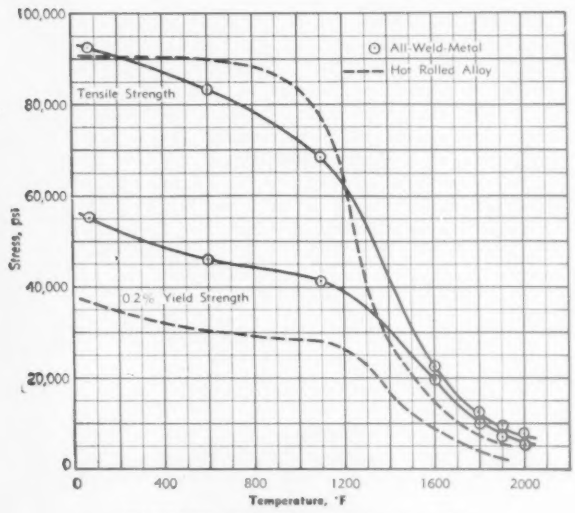
Side-bend test specimen from butt joint between carbon steel (l.) and INCONEL alloy 600 (r.) welded with INCONEL Welding Electrode 182.



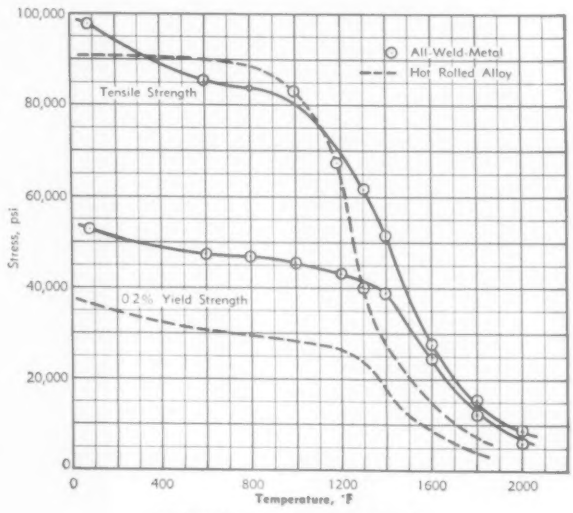
Side-bend test specimen of one inch thick butt joint between carbon steel (l.) and INCONEL alloy 600 (r.) welded with INCONEL Filler Metal 82.



Side-bend test specimen from butt joint of INCONEL alloy 600 (both sides) welded with INCONEL Welding Electrode 182.



INCONEL Welding Electrode 182
High Temperature Tensile Properties of All-Weld-Metal Deposits



INCONEL Filler Metal 82
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INCONEL Welding Electrode 182 is a true all-position electrode in every respect — operability, slag removal, and weld quality.

The tolerance of the weld metal to dilution by iron makes these materials an excellent choice for welding INCONEL alloy 600 to carbon or stainless steels and for overlaying.

For complete information on these two new products, write for our descriptive bulletin and a reprint of the *Welding Journal* paper, "Welding of Nickel-Chromium-Iron Alloy for Nuclear-Power Stations."

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EXAMINING the "hot side" of an aluminum armored plate sample used in a series of ballistic tests, a technician points to a hole made in the plate while the group supervisor holds a round of 37mm shell used for the test.

Welded aluminum passes tests for use in armored vehicles

Aluminum armor plate has passed the last in a series of ballistic tests designed to prove its capabilities for wide-spread use in U. S. Army armored vehicles.

A 37mm high-explosive shell was fired directly at a weld and although the explosion left a pockmark, the round did not penetrate the 1¼-in.-thick aluminum.

Tough welded aluminum alloy can thus make armor effective against small arms fire and artillery shell fragments and keep weight down.

The tests were conducted by the Ordnance Section, Proof and Development Section, of the U. S. Army at the Aberdeen Proving Ground in Maryland.

Pyramid changes name to Amprobe Instrument

Pyramid Instrument Corp., Lynbrook, N.Y., has changed its name to Amprobe Instrument Corp.

Nooter plans $1 million expansion program

The Nooter Corp., St. Louis, is planning a $1 million expansion program which will permit the firm to produce vessels weighing up to 250 tons.

The project is expected to be complete by 1962.

Bankhead Welding Service enjoys rapid growth

Bankhead Welding Service, Inc., Atlanta, Ga., has recently celebrated its 15th anniversary.

The firm, owned by Glenn Taylor, began as a one-man backyard operation in 1946 and has become an 80-man operation with 40 Hobart arc welding units and over 20 portable service trucks.

NCG builds plant, awards welding grant

A 120-ton-per-day oxygen, nitrogen and argon plant will be built at Texas Instruments Inc., Dallas, by the National Cylinder Gas Div., Chemetron Corp., Chicago.

NCG has also selected James W. Bradley and James H. Frazier as 1961-62 recipients of their Welding Engineering Scholarships to Ohio State University.

In further news, NCG has obtained exclusive sales and service rights in the United States and Canada to products of Alfred J. Amsler & Co., Schaffhausen, Switzerland.

AWS New York Section plans welding course

The education committee of the Northern New York Section of the American Welding Society will give an 8-week course on welding metallurgy starting October 3.

Sessions will be from 7 to 9 p.m. on Tuesdays at the Rensselaer Polytechnic Institute, Troy, N.Y.

For further information, contact K. C. Wu, Watervliet Arsenal, Watervliet, N.Y.

F. P. Kohlbry retires from Machinery & Welder Corp.

After nearly 35 years as president of Machinery & Welder Corp., Skokie, Ill., F. P. "Dutch" Kohlbry is retiring from welding distribution.

Kohlbry has sold his interest in the company to employees and will devote his full time to the Airtherm Corp., St. Louis.

Welding institute will be for high school teachers

The second annual welding institute for high school welding instructors will be held at the University of Wisconsin and the Madison Vocational School in Madison, Wis., on October 21.

The institute is being presented through the combined efforts of the Madison-Beloit AWS Section, the mechanical engineering department of the University and the Madison Vocational School.

One of the speakers for the institute will be T. B. Jefferson, publisher of WELDING ENGINEER.

AWS moves to new engineering center

The American Welding Society is planning to move into its new home, the United Engineering Center, within a few days.

The 20-story all-welded building faces United Nations Plaza and will house 19 major engineering societies representing a combined membership of over 300,000.

The library, probably the most comprehensive engineering library in the world, will occupy the entire second floor with sub-floor areas for stacks.

The present building, founded by Andrew Carnegie, has been the home of AWS since 1919.

Crucible installs tensile test furnaces

Crucible Steel Co. of America has recently installed two vacuum tensile test furnaces at its Central Research Laboratory in Pittsburgh.

The furnaces will be used to determine strengths of space age metals under conditions simulating those hundreds of miles above earth.

Compressed Gas Assn. moves to new office

The Compressed Gas Association has moved to new offices in Room 2400 at 500 Fifth Ave., New York 36, N.Y.

The new office is just one building away from the former location.

Lincoln opens new office-warehouse

THIS combination office-warehouse has been constructed at 1625 Sublette Ave., St. Louis 10, Mo., by The Lincoln Electric Co., Cleveland. The pre-fabricated welded steel structure is 40 ft by 122 ft and has 3,280 sq ft of floor area.

International salesmen attend welding course

Industrial application engineers who represent Armco International Corp. in England, Argentina, Peru, Brazil, and Mexico recently completed an arc welding program at Lincoln Electric Co., Cleveland.

Information presented emphasized the practical as well as theoretical details of production welding and weld design.

Lincoln Foundation appoints awards jury

The James F. Lincoln Arc Welding Foundation, Cleveland, has appointed a jury for the foundation's $25,000 Award Program for Progress in Arc Welded Design.

The jury includes: Professor J. Wayne Deegan, head of the mechanical engineering department of the University of Iowa; James B. Green, assistant chief engineer of the industrial division of Jeffrey Mfg. Co., Columbus, Ohio; Carl L. Kreidler, chief engineer of the Lehigh Structural Steel Co., Allentown, Pa.; and Van Rensselaer P. Saxe, design consultant, Baltimore.

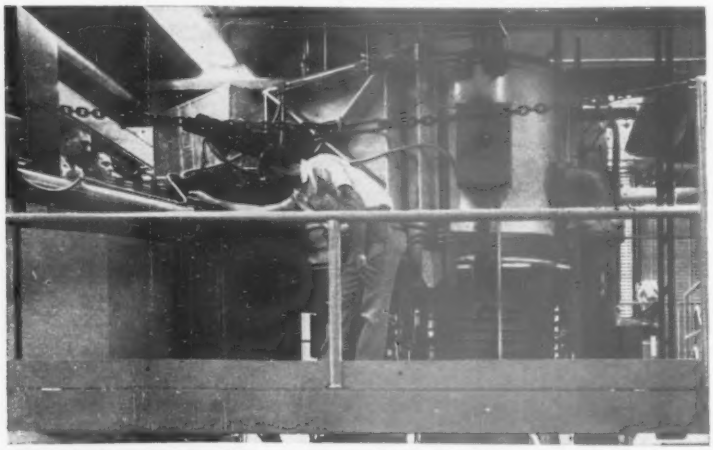
Alloy Rods Co. begins new 5-lb packaging

A new 5-lb package for electrodes to meet the needs of small quantity users who weld cast iron is now being produced by Alloy Rods Co., York, Pa.

Six moisture barrier tubes are packed in a standard carton. The package is designed for electrodes 1/8-in. diameter and larger.

(More news on page 77)

Haynes installs electron beam furnace



PURE columbium and tantalum ingots are melted in the heart of this 300-kw electron beam furnace recently installed at Haynes Stellite Co., Div. of Union Carbide Corp., Kokomo, Ind. The furnace can produce ingots up to 8-in. diameter and 42-in. long. The furnace is part of the company's facilities to produce refractory metals in mill form.

COMING EVENTS

SEPT. 12-14: 3rd Annual Southeastern Maintenance and Engineering Show, Greensboro War Memorial, Greensboro, N. C.

SEPT. 14-15: NWSA Central Zone Meeting, Palmer House, Chicago.

SEPT. 19-20: NWSA Eastern Zone Meeting, Hotel Roosevelt, New York City.

SEPT. 18-22: Summer Conference Course on X-Ray and Radioisotope Nondestructive Test Techniques, The Ohio State University, Columbus, Ohio.

SEPT. 20-22: AEC Welding Forum — Annual Meeting, Southwest Research Institute, Granada Hotel, San Antonio, Texas.

SEPT. 25-28: Fall Meeting, American Welding Society, Adolphus Hotel, Dallas, Texas.

OCT. 9-10: NWSA West Central Zone Meeting, Radisson Hotel, Minneapolis.

OCT. 12-13: NWSA Western Zone Meeting, Riviera Hotel, Las Vegas, Nev.

OCT. 16-20: National Safety Congress and Annual National Safety Council Convention, Chicago.

OCT. 23-25: Fall Meeting, Abrasive Grain Association, Waldorf-Astoria Hotel, New York City.

OCT. 23-27: 43rd National Metal Congress, American Society for Metals, Cobo Hall, Detroit.

DEC. 4-6: Winter Meeting, Independent Oxygen Manufacturers Association, Alffer Hotel, Mexico City.

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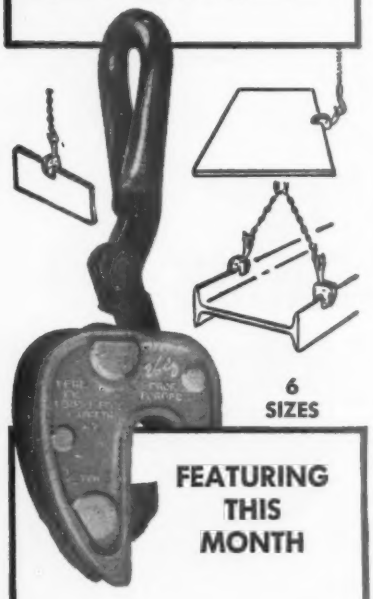

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Circle No. 157 on Welding Info-Aid Card

Letters

Too many shows?

I have read the letter appearing in WELDING ENGINEER signed by an anonymous person as "Show Tired." It makes a specific recommendation to AWS setting forth a possible solution to the problem of too many shows. . .

Approximately two years ago a special committee was formed to study the subject of regional shows and make a recommendation on how they could be organized and controlled. The recommendations of this committee were accepted by the Board of Directors of the American Welding Society.

Quoted from AWS Board of Directors Rules:

"B 7 *Expositions.* An exposition may be defined as a show with a commercial aspect. The Society favorably endorses exposition activities at the District level with a stature which reflects credit to the Society.

"The following rules shall apply for holding District sponsored expositions. These rules, however, shall not apply to symposiums, conferences, general meetings and the like which are held for educational purposes.

"1. Only a District may sponsor an exposition. A Section desiring to organize and sponsor an exposition must first receive approval of its District Director and through him cooperation and support from a majority of the Sections in his District.

"2. A District may hold such an exposition not more than once every two years.

"3. A District may not hold such an exposition within 18 months of a National convention (either the annual meeting or the fall technical meeting) held within that District.

"4. A District desiring to hold an exposition shall, through its District Director:

a) Submit recommendation to the Exposition Committee, setting forth the suggested time, place, facilities, and general plans and objectives for the exposition,

b) Receive written approval from the Exposition Committee for such an exposition 6 months prior to the proposed time the exposition is to be held,

c) Obtain insurance in the amounts of: $300,000 public liability and $100,000 personal liability,

d) Organize, either with local talent or in cooperation with a local educational institution, a technical program to run in conjunction with the exposition,

e) Pay to the National Society $500 or 5% of the space sales, whichever is greater, for guidance and advisory services including:

1. Suggested guide rules for conducting a successful exposition.

2. General counsel of Convention and Exposition Managers.

3. Promotion suggestions and guidance by Publicity and Promotion Managers.

4. Technical program suggestions by National Papers Committee."

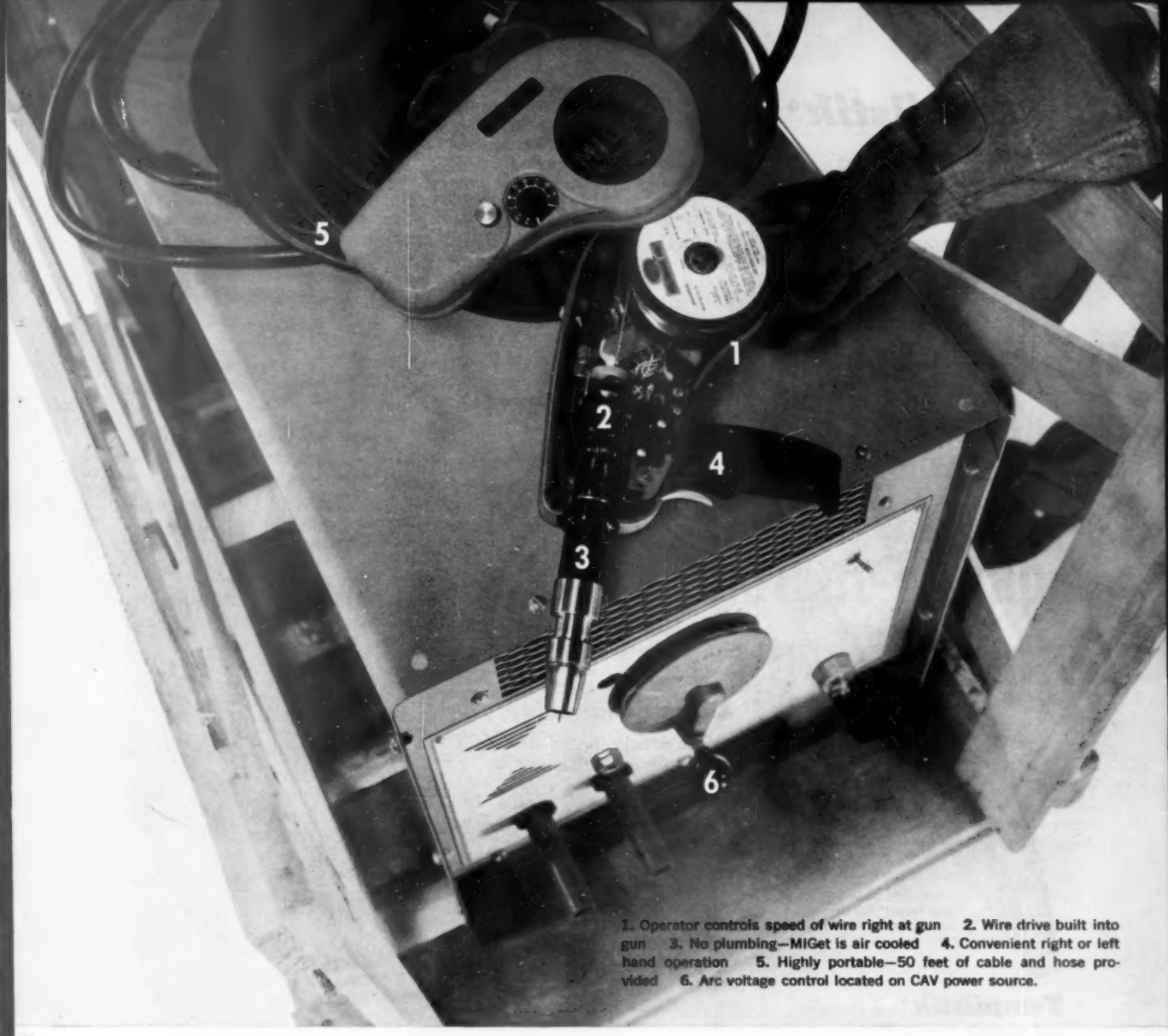
James E. Norcross
Exposition Committee
Chairman
American Welding Society

Flame straightening

In answer to the letter . . . on Flame Straightening printed in the July, 1961, WELDING ENGINEER, Joseph Holt has been nationally recognized by the Corps of Engineers, BUSHIPS and many other fabricators as the most reliable practitioner of flame straightening. Whether or not he originated the process is a matter of opinion, but he is the only person who has been able to rehabilitate damaged steel structures while under a load with such precision that the repairs are not discernable after the job is repainted.

It is no great achievement to bend free members with heat. . . sophomore mechanical engineering students at the University of Washington do this with only 15 minutes of instruction. As for the double vee cambering technique, you will produce yield point tension in both flanges of the beam and thus obtain an unstable stress pattern that will result in plastic flow when loads are applied. Such a camber is only partially permanent and gives rise to severely adverse stresses in a beam web. . .

Joseph Holt is not pretending to be the only person capable of



1. Operator controls speed of wire right at gun 2. Wire drive built into gun 3. No plumbing—MIGet is air cooled 4. Convenient right or left hand operation 5. Highly portable—50 feet of cable and hose provided 6. Arc voltage control located on CAV power source.

DO HI-SPEED AIRCOMATIC WELDING ANYWHERE—$995*

with new MIGet UNIT PACKAGE! (no separate control needed) only

Airco now gives you the simplest, lowest price gas-shielded metal-arc welding package in the industry —

(1) Hi-speed highly portable MIGet welding gun, with handy knob to adjust wire feed speed; model AH20-E.

(2) New Aircomatic MIGet CAV power source, with control to adjust arc voltage.

The new MIGet UNIT PACKAGE enables you to make numerous short-length welds . . . at a remarkably low cost. You can work up to 50 feet from the power source, on anything from radar antennas to crawl-in tunnels.

You can weld mild steel with Dip Transfer using CO_2 or AG25; aluminum with Spray Transfer or Dip Transfer using argon; stainless steel with Dip Transfer using AG1.

The MIGet gun connects directly to the power source. It weighs only 2¾ pounds. Handles .030" and 3/64" aluminum wires, and .030", .035" and .045" hard wires. It is rated at 200 amperes 100% duty cycle.

The power source, in which the "welding current takes care of itself," is a single phase, DC rectifier, CAV type, rated at 200 amperes 60% duty cycle. Reactance for Dip Transfer is built in.

Here is Aircomatic-quality gas shielded metal arc welding at an unmatched low price of $995!*

Airco — and only Airco — makes everything you need for any kind of welding. Call your nearest Airco office or Authorized Airco Distributor. Look in your Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Airco representative.

*Zone I price. Zone II price—$1015.00

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More than 700 Authorized Airco Distributors Coast to Coast

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For more facts Circle No. 158 on Welding Info-Aid Card

Tempilstik°

*temperature indicating crayons**

*Also Tempil° Pellets and Tempilaq° (liquid form)

Tempilstik°—a simple and accurate means of determining preheating and stress relieving temperatures in welding operations. Widely used in all heat treating—as well as in hundreds of other heat-dependent processes in industry. Available in 80 different temperature ratings from 113°F to 2500°F . . . $2.00 each.

Send for free sample Tempil° Pellets. State temperature desired . . . Sorry, no sample Tempilstiks°

Most industrial and welding supply houses carry Tempilstiks° . . . if yours does not, write for information to:

WELDING SALES DIVISION

Tempil° CORPORATION
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Visit us at Booth 928, 1961 ASM Show, Cobo Hall, Detroit, Michigan, October 23-27

Circle No. 159 on Welding Info-Aid Card

using flame straightening— he only desires to see it properly administered. You should rejoice that you have had considerable success and congratulate this man who has pioneered the rehabilitation of damaged structures by selectively applied heated zones. His work can mean a great deal to the welding industry if it ever stops fighting over who discovered it.

Richard E. Holt
Assistant Professor
University of Washington
Seattle, Washington

Welding Encyclopedia

Enclosed is a check for another copy of your 14th edition of the WELDING ENCYCLOPEDIA. They must be good; I can't seem to keep one for myself.

E. W. Weinberger
Regional Serviceman
National Cylinder Gas Div.
Denver, Colo.

Billion dollar industry?

Your article in the Mid-June issue boasts of welding as a billion dollar industry. Further reading of the article shows that this is not so, although it certainly should be.

Taking your figures for oxygen consumption and deducting the amount not used for welding or related processes, which by your figures is about 40%, would reduce the industry total by $160,516,000 to $983,346,000. This figure should be further reduced by $260 million if we apply your estimate that only 30% of the acetylene produced is used for welding and related uses . . . The total then becomes less than three-quarters of a billion dollars.

The intent of this letter is not to quibble about numbers. My point is that in publishing your original figures you inadvertently encouraged the complacency of the welding industry today.

The welding industry should be a billion dollar industry today. It should be a two billion dollar industry in 1965 as you predict. But these figures will never be attained if we are satisfied to let the gains occur from the efforts of others and if we continue to ignore the large portion of the welding market which is untapped.

Simon A. Greenberg
Industrial Consultant
Flushing, N.Y.

Noble heritage

I have just read your editorial *Our noble heritage* and think it is one of the finest little things I have read in a long time. I further think this thing should be given wide publication. I trust someone will pick up the torch and carry it through, so that it may receive wide distribution.

Stanley H. Keen
Keen Compressed Gas Co., Inc.
Wilmington, Del.

I wish to compliment you on your editorial entitled *Our noble heritage* in the July issue. . .

I hope that everyone reads your factual picture on patriotism and where it stands with such a high percentage of our people. . . Keep up your perserverance in a continuing effort to do your part in this important phase of our lives.

V. B. Anderson
V. B. Anderson Co.
Santa Ana, Calif.

I read your editorial entitled *Our noble heritage.*

I cannot help but take time out to congratulate you on a well-written editorial explaining the facts. . . It is only too bad that more people do not read and try to understand what is happening to our once great country. We are certainly developing a complacent "so what" attitude.

I encourage you to keep up this good writing. We need this type of material more and more today. Call the "shots" as you see them. It's bound to make an impression sooner or later.

John T. Zurlo
Plant Manager
Sheridan Iron Works, Inc.
Champlain, N.Y.

Belated congratulations

LAUASANNE, SWITZERLAND — PLEASE ACCEPT BELATEDLY MY HEARTIEST WISHES TO WELDING ENGINEER AND ITS LEADER FOR OUTSTANDING EFFORTS IN DEVELOPING AN INTERESTING MAGAZINE FOR THE WELDING PUBLIC. CONGRATULATIONS. HOPE WE WILL ALL BE AROUND TO DO IT AGAIN IN ANOTHER 45 YEARS.

Rene Wasserman
Chairman of the Board
Eutectic Welding Alloys Corp.

• For improved
MIG welding to 200 amperes...

GLENN CV200

Single-Phase

Constant-Voltage DC Power Supply

Model CV200 is only 19" wide x 25½" deep x 31" high; weighs 375 lbs.

Under development and field testing for the past 1½ years, the GLENN CV200 Single Phase power supply offers the finest performance available today in MIG power supplies of comparable rating.

Exclusive GLENN circuitry (patent pending) is designed especially to provide the correct volt-ampere slope for gas-shielded, wire-fed arc welding — including the entire range of short arc welding and spray-arc up to 200 amperes.

Other advantages include:

- **SINGLE-PHASE INPUT at 230 or 460v — no costly special wiring required.**
- **LOW INPUT — only 17 amp at 460v or 34 amp at 230, at full rated load.**
- **SIMPLIFIED CONTROL — set the desired voltage on the vernier dial and you're ready to weld. Balanced constant-voltage circuit automatically provides correct volt-ampere slope for MIG welding at its best.**

Rated output is 200 amps at 30 vdc, 100% duty cycle. Open circuit output voltage range is 8.5 to 53 on 230/460v input.

Because of its compactness, low initial cost and ease of installation, the GLENN CV200 makes the benefits of MIG welding practical and possible for many new applications. Why not get the facts **now?** Write today for literature, prices.

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703 - 37th AVENUE • OAKLAND 1, CALIFORNIA
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7

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helps build things...

things like freight and passenger trains, things that help keep the busiest nation in the world on the move. Whatever your application, in building or maintenance, a rod stamped "Bridgeport" offers dependable performance . . . uniform quality. All Bridgeport alloys tin well... flow freely... produce dense, sound welds of high strength and ductility. They're available in standard rod sizes and lengths, as well as coils and spools for automatic equipment. Order from your local distributor.

Get your free copy of Bridgeport's "Bronze Welding," write:
BRIDGEPORT BRASS COMPANY, Bridgeport 2, Connecticut

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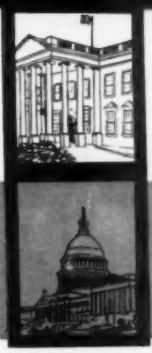
BRIDGEPORT BRASS COMPANY
Specialists in Metals from Aluminum to Zirconium



dateline: WASHINGTON

Prosperity is just around the corner --again. At least this is the conclusion to be reached from all the activity in Washington the past few weeks.

After numerous faulty predictions on the recession's bottoming-out (first May, then June, and finally July), a sharp upturn in the already-recovering economy seems certain. Termed the Berlin-boom by some, it centers on the four billion plus increase in defense dollars and the authorization to callup 250,000 reservists.

With the bulk of the money being earmarked for military hardware production ($1.8 billion alone is alloted to new procurement orders for conventional arms and equipment), the economy should get that extra jolt into the anticipated boom-era. If this increased industrial production — besides putting much money into circulation — doesn't take a healthy cut out of the unemployment figures, the jobs vacated by recalled reservists should.

(Last month, gremlins got into the typewriter: the 66.8 million figure referred to employment, not unemployment.)

At any rate, there is going to be more business in almost all areas. The question remains: how fast will the boom develop and can it sustain itself after Berlin is no longer an incentive?

* * *

Also aiding industry is the proposed tax credit for spending on machinery and equipment. The House Ways and Means Committee's version calls for an 8% across-the-board credit on purchases of machinery and equipment up to a maximum of 50% of the company's tax bill. (The administration had recommended 30%.)

Despite the bill-killing possibility of increased taxes to pay for additional defense spending, the bill's survival chances look good if the tax credit is cut to 5 or 6%, as recommended by Treasury Secretary Douglas Dillon.

* * *

Steps are also being taken to assure small business its fair share of the increased defense allocation. A joint industry-government task force is being formed to develop and implement measures for increasing small business' share of subcontracts, according to the Small Business Administration's John E. Horne.

At a meeting of large prime contractors, industry association representatives and government procurement officials, the task force's general objective was detailed: to increase the number and dollar amount of subcontracts going to qualified small businesses. In particular, the three point program will:

(1) Create a subcontracting audit system whereby SBA may make examinations of small business subcontracting practices of large firms receiving prime government contracts; (2) Establish rules or regulations for the improvement of the small business subcontracting share of Government procurement for both industry and governmental levels; and (3) Study methods to improve communications to small firms on government procurement practices and opportunities on subcontracting.

* * *

The first half of 1961 looked like a domestic version of the mating game. According to tabulation by the Federal Trade Commission, mergers and acquisitions recorded for the January to June period were 540, compared with 525 in the same period of 1960, 521 in 1959 and 443 in 1958. And as reported in WE's WeldWorld, the welding industry has had its fair share of marriages.

SEE HOW PAGE PROVIDES THE

SELECTION
PACKAGING
SERVICE
INVENTORY CONTROL

to improve your welding operations

You can get just the right wire for your welding operations from PAGE. Because we offer a choice of 33 analyses—the largest selection in the industry—wires are available for practically any job. And when a particularly *tough* welding problem exists, PAGE can often develop a special wire to solve it.

From single coils to 1200-lb. Payoff-pallets, PAGE can supply the packaging that offers you the greatest convenience in handling, storage and use. You can specify the packaging that meets *your* requirements.

Nationwide service helps you meet your welding needs quickly and efficiently. A coast-to-coast network of distributors, backed by strategically located warehouses, assures prompt delivery.

Typical color-coded label for reels—as grades of wires change, so do colors

Cartons, spools, Payoffpaks and Leverpaks included in PAGE color-coded packaging

Simplified inventory and reduced scrap loss are the results of PAGE's new color-coding program. For the first time, you can purchase *all* your automatic welding wire with permanent, color-coded identification. What's more, each color-coded label shows complete data on grade, size, heat number, weight and order number.

In all these ways, PAGE can help improve the quality of your welding operations, reduce your costs, simplify your stocking and handling. PAGE welding specialists are available to give expert advice. That's why it makes sense to bring your welding problems to PAGE.

***Write** for information on the complete line of PAGE welding wire. **Folders DH-402** and **DH-1218** list PAGE analyses, describe packaging, include most competitive makes. New color-coding identification card available.*

PAGE WELDING WIRE

Page Steel and Wire Division • American Chain & Cable Company, Inc.

Monessen, Pa.*, Atlanta, Chicago (Melrose Park)*, Denver*, Detroit, Houston*, Los Angeles* New York, Philadelphia*, Portland, Ore., San Francisco*, Bridgeport, Conn. *Indicates PAGE warehouse stocks

ACCO

—the source for answers to welding problems

Your September, 1961

Weld World

As WE went to press, these were the industry's latest developments:

. . A fine-wire production welding system was introduced Aug. 11 by Westing-Arc Dept., Westinghouse Electric Corp., Buffalo. More details next month.

. . Reed Roller Bit Co. has purchased Diamond Metal Co., Houston, producer of hardfacing alloys, and the latter is now operating as Reed's Diamond Metal Division. All of Reed's production activities in this field will now be undertaken by Diamond, which plans a stepped-up research and development program aimed at increasing its prominence as a major supplier of hardfacing and corrosion resistant alloys.

. . National Cylinder Gas Div., Chemetron Corp., Chicago, has become the only national distributor for the Safety Products Div. of American Optical Co., Southbridge, Mass. It has also become a national distributor for the arc welding accessories made by Tweco Products, Inc., Wichita, Kans. NCG has dropped all other safety and arc accessory lines with the exception of the Bernard "Shortstub" electrode holder.

. . In an exchange of stock, Marquette Corp., Minneapolis, has purchased Regent Equipment Mfg. Co., Ltd., Rexdale (Toronto), Canada, manufacturer of arc welding equipment, battery chargers and testers. Regent, which is said to have built the first arc welders in Canada, will operate as a wholly owned Marquette subsidiary.

. . Headquarters of the American Welding Society were moved the first of this month from 33 W. 39th St. to the new United Engineering Center at 345 E. 47th St. in New York City.

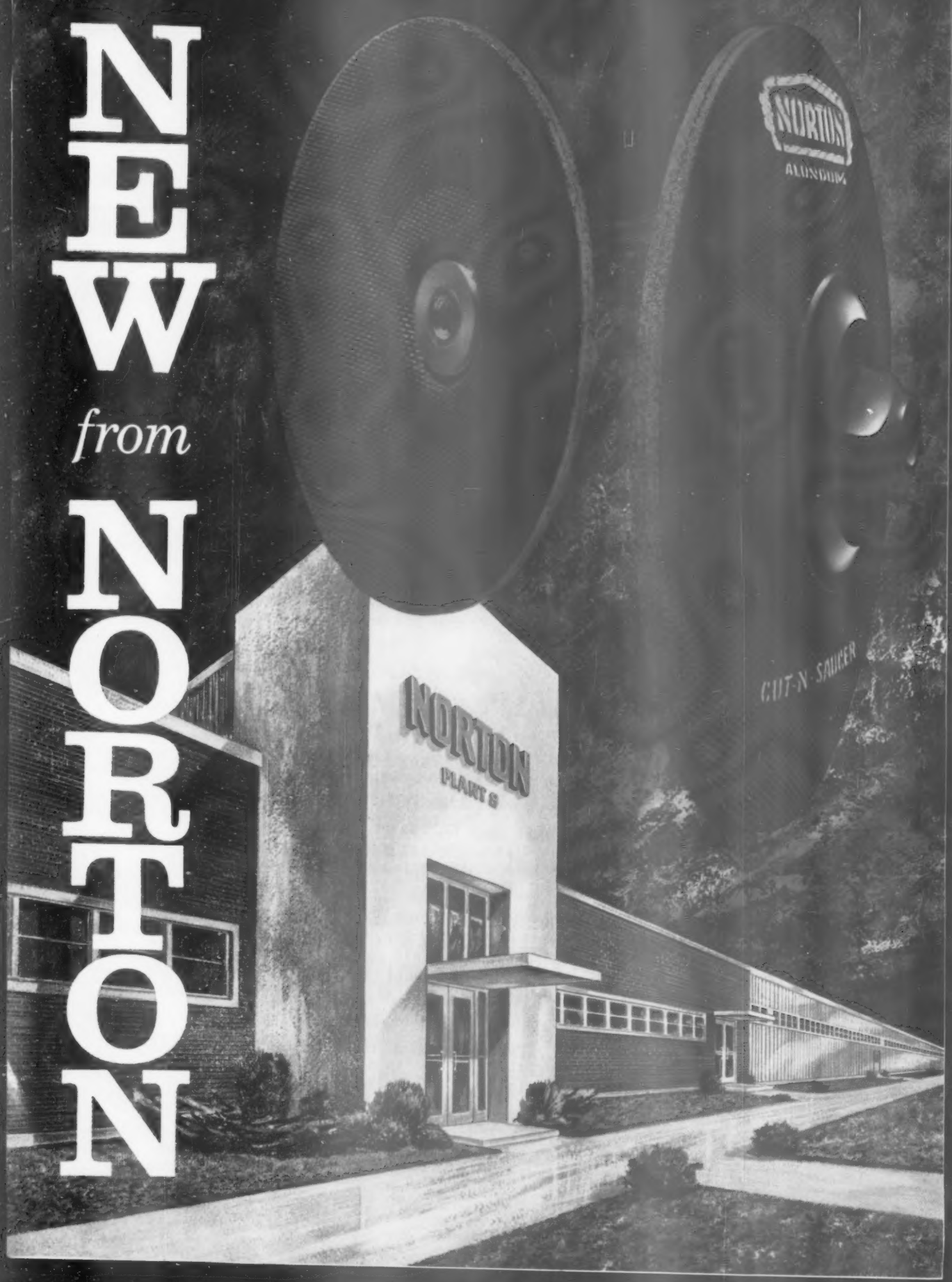
. . Norton Co., Worcester, Mass., manufacturer of abrasives and grinding wheels, is studying means of creating a public market for its stock. Also under active consideration is an employee stock purchase plan.

. . A novel method of applying hardfacing alloys to power shovel buckets is reported by Stoody Co., Whittier, Calif. Instead of beads, dots of hardfacing materials are laid down close together. Advantages cited: reduction of heat input and longer equipment life, since abrasive dirt packed between dots works against abrasive dirt, protecting both bucket and hardfacing.

. . Air Products, Inc., Allentown, Pa., has added "and Chemicals" to its corporate name — "to more accurately describe the company's expanding activities."

. . Price cuts are always good news to the consumer. The latest: Sylvania Electric Products Inc. has reduced the price of its tungsten welding electrodes. Depending upon the type, cuts range from 4% to 23% — the largest decreases on 2% thoriated and Zirtung electrodes.

NEW *from* NORTON



CUT-N-SAUCER wheels with DIS-CARD mounts

A new combination from Norton's newest plant

For easier, faster weld-grinding, light snagging and many other portable grinding jobs, Norton now offers you:

The only reinforced wheels that combine a saucer shape with a disposable mount.

These are the new BSA Type Cut-N-Saucer wheels with Dis-Card mounts . . . available in 7″ and 9″ diameters. They are produced in the big new Norton Plant 8, built specifically to improve the manufacture and performance of resinoid wheels.

Reinforced with layers of fibre glass, BSA Cut-N-Saucer wheels gain added advantages from the new shape. Compared with straight wheels, BSA wheels on the job can be held at angles much closer to the horizontal. Results are easier control and reduced operator fatigue.

The Dis-Card mount is equally new and vital. Unlike ordinary mounts it is no separate attachment. It is permanently secured — designed to be bought and thrown away with every wheel. This means you can change wheels in seconds — completely eliminating "lock washer" action and the usual mounting routine that can take up to half an hour. So every Cut-N-Saucer wheel you buy is already mounted — and *stays* mounted, throughout wheel life.

Yet you pay no more for a Norton Cut-N-Saucer than for a conventional reinforced wheel!

Cash in on this first opportunity ever offered to you to get advantages never before combined in a single, standard priced, portable grinding wheel. For further facts on the new BSA wheels — or on straight wheels also with Dis-Card mounts — see your Norton Distributor, or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

NORTON
ABRASIVES

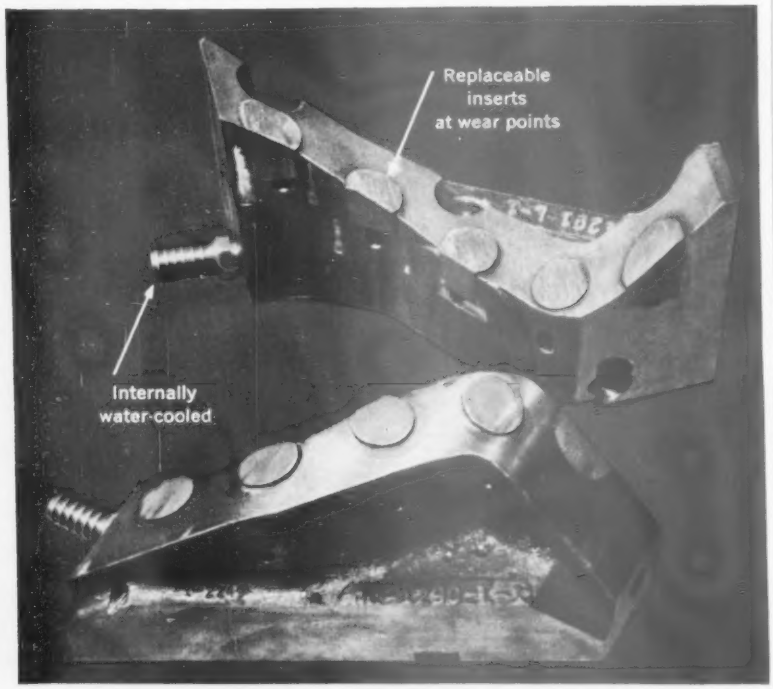
W-2017

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

AMPCO®

7 times longer life for projection welding die!



Replacement time and cost reduced almost 75%!

Originally, the projection welding die shown here was cast to contour in one piece and not internally water-cooled. Its life was short. Replacement was expensive, in terms of both money and downtime.

Then Ampco's experience was drawn upon. Working surfaces were changed to incorporate relatively inexpensive refractory inserts which could be quickly replaced. Adequate water-cooling was provided, also. These two factors vastly increased die life.

Ampco has complete facilities and the know-how for making welding dies of all types — flash, butt, projection, and cross-wire. Your Ampco-Weld distributor can put them to work for you. Call him. Write for Bulletin RW-10.

RESISTANCE WELDING ALLOY ASSOCIATION RW AA

RW-28C

AMPCO METAL, INC., Dept. 187I, Milwaukee 1, Wis.
West Coast Division: Huntington Park, Calif. • Southwest Division: Garland (Dallas County), Tex.

In retrospect

(Taken from **Welding Engineer** issues of September 1916, 1931, 1946)

—45 Years Ago—

We know of a certain so-called welding school which charges students $50 for a complete course . . . . The students turned out by this particular school can by no stress of imagination be called weldors . . . . This is injurious to the entire welding industry, and we are inclined to think that the proprietors of such schools who deliberately publish false and misleading advertising should be prosecuted.

—30 Years Ago—

Founded as a repair shop, the firm of Peters and Marske, operated by Fred G. Peters and Leo G. Marske at Michigan City, Ind., has installed a Job Division handling a complete line of welding equipment and supplies. This department is managed by H. C. Clark.

Metal & Thermit Co., New York City, with the Murex Welding Processes, Ltd., England, has formed the American Murex Corp., which will manufacture the Murex line of electrodes at Jersey City, N. J.

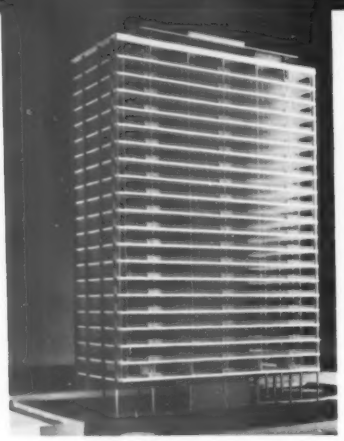
The Page Steel and Wire Co. is opening an office in Atlanta, Ga., at 1520 Healey Bldg. R. J. Teeple will be in charge of the new district sales office.

—15 Years Ago—

Air Products, Inc., Allentown, Pa., has acquired the 32-year-old K-G Welding and Cutting Co., New York City. Chester T. Price, chairman of Air Products' executive committee, has been elected president of K-G, which will operate as a wholly owned subsidiary.

Frank V. Lockefer has been appointed general sales manager for Mid-States Equipment Corp., manufacturer of welding equipment.

For more facts Circle No. 164 on Welding Info-Aid Card
For more facts Circle No. 165 on Welding Info-Aid Card →



New National Electric welding cable. Flexible, but tough enough for your job.

NATIONAL ELECTRIC is the *Speedy* way to put power in place

Highland Tower Apartments, Pittsburgh, Pa.
22 floors, welded frame construction
Architect: Tasso Katselas
General Contractor: Navarro Corporation
Welding by Crawford Steel Construction Co., Inc.

FOR MORE INFORMATION...

NATIONAL ELECTRIC WELDING CABLES . . . made to last longer, cost less.

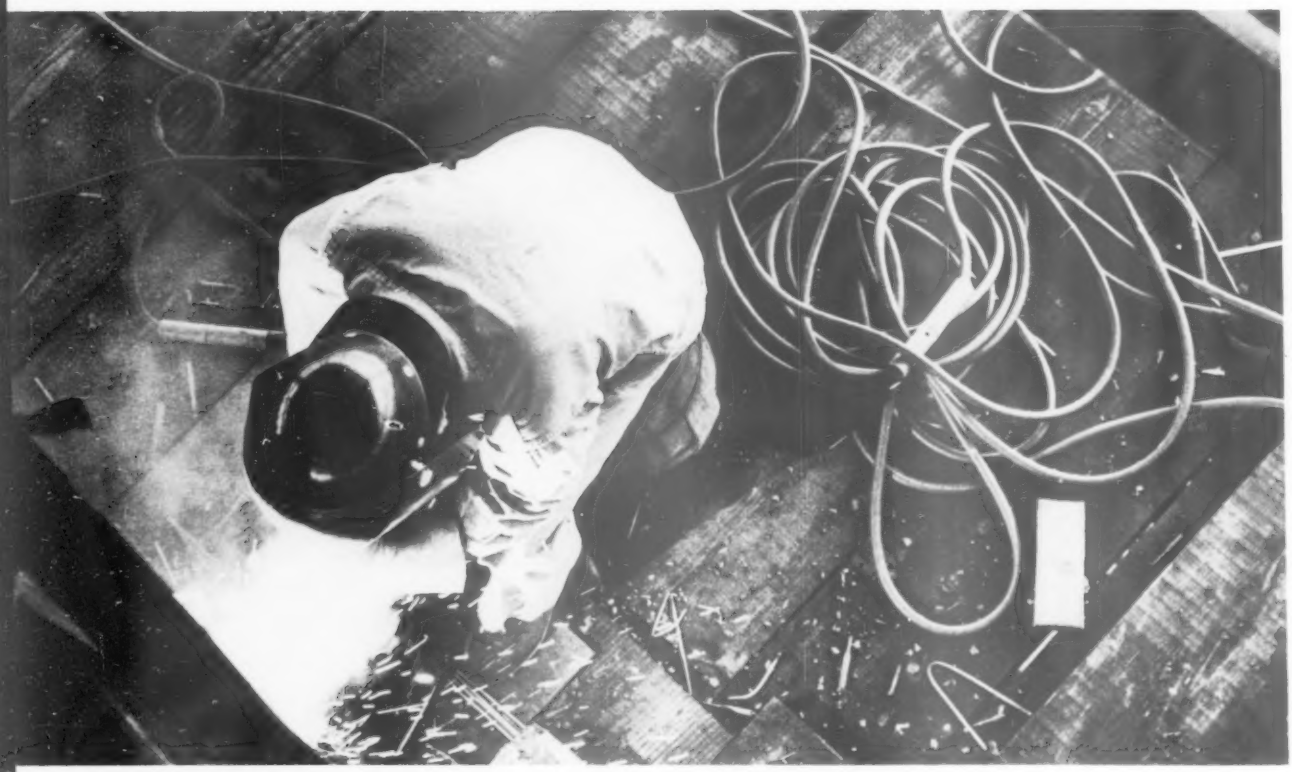
Maximum flexibility and resistance to abrasion and impact . . . National Electric welding cable has both.

The extra-flexible conductor is made of fine, soft copper wire, No. 34 A.W.G. A special, paper-strengthened aluminum foil separator over the conductor keeps the copper strand clean, and permits easy stripping. Flexibility with strength is given the outer insulation by specially compounding GR-S synthetic rubber.

For special resistance to flame, oil, weather, acids and alkalies, National Electric makes neoprene sheathed cable that meets all ASTM D-752 standards. Mold cured neoprene cable with reinforced jacket is also available, made to IPCEA standards.

SIZE AWG	STRANDING #34 AWG	NOM. O.D.	APPROX. SHIP. WGT.		AMP. CAP. 90° Cable	VOLT. DROP Per 100'	STANDARD PACKAGES
			Rubber	Neoprene			
6	665	.390	137	152	75	3.58	250
4	1064	.450	191	205	100	3.18	250
3	1330	.480	254	273	150	3.70	250
2	1672	.550	316	342	200	3.92	250, 500, 1000
1	2109	.600	395	422	250	3.88	250, 500, 1000
1/0	2660	.660	485	510	300	3.72	250, 500, 1000
2/0	3325	.730	592	630	375	3.68	250, 500, 1000
3/0	4256	.800	750	800	450	3.51	250, 500, 1000
4/0	5320	.870	935	995	550	3.41	250, 500, 1000

National Electric welding cables . . . rubber or neoprene sheathed



Speedy Sez— **Just ask your Welding Supply Distributor** . . . or write National Electric Division, H. K. Porter Company, Inc., Porter Building, Pittsburgh 19, Pa.

PORTER *NATIONAL ELECTRIC DIVISION*
H. K. PORTER COMPANY, INC.

Index No. 1
Form No. 716

Between passes

a man retires

J. B. (Jerry) Welch retired this summer.

To many of our readers in the resistance-welding field, Jerry needs little introduction. He has been the guiding light behind Cutler-Hammer's resistance-welding activities since the early 30s.

When he first joined the Milwaukee firm in 1928, he worked as an inspector. His previous welding experience included running a small job shop on his farm in Webster City, Iowa. But it was in resistance welding that the new inspector showed his greatest interest — and later achieved his greatest accomplishments.

"There was more of a challenge in the resistance field than in the other welding processes at that time, especially at Cutler-Hammer. In 1933, all our operations were done on 25-cycle equipment . . . During the early years of the depression, the big improvements in equipment included better designed ignition tubes and timing devices," Jerry reminisced in a recent interview.

He himself designed and built some of the first electronic timers used at Cutler-Hammer — about 20 years ago — and some of these are still in use. Welch has seen the industry grow right along with the process at C-H. From three machines in the early 30s, this activity has grown to a complex of approximately 150 machines.

He has eleven patents in his name. Low-voltage magnetic-force percussion welding was developed by him at Cutler-Hammer. The process is now used extensively by Cutler-Hammer in welding dissimilar non-ferrous metals, especially silver cadmium to other alloys. (Two machine builders have been licensed by the firm to manufacture welders from the original Welch design.)

Jerry modestly credits much of his success to his colleagues and to the management at C-H. He feels his job was made easier by the active cooperation of the lat-

" . . . many cannot judge value except by price."

ter. His chief concern in the beginning was educating people of the importance of the resistance joining process — and what it could do for them. An example of this educational effort was the setting up of training programs for other groups in the plant — designers, draftsmen, engineers, etc. The natural result: a greater use of resistance welding at C-H.

In addition to in-plant programs, Jerry has set up courses at Milwaukee vocational school.

Jerry's many accomplishments in industry are not confined to welding. He helped found a local chapter of the X-ray society, predecessor to the Society for Non-Destructive Testing. He built much of the calibration equipment for C-H circuit breakers — the first one about 1938. He was the first (at least at his plant) to use air ejection of parts on punch presses. (In those early days labor was thought to be cheaper than air.)

During his 33 years with the firm, he was often called upon to give guidance to other Cutler-Hammer plants and affiliated foreign companies. In many cases, his recommendations have become standard operating procedures at these plants — much as has happened at the main Milwaukee facility.

This exchange of ideas was and is not limited to Cutler-Hammer affiliates. Jerry, as process and manufacturing engineer, has traveled well over 100,000 miles visiting automobile, appliance and other types of manufacturers for the sole purpose of such exchange. Many of his contacts have been made through membership in various technical societies. Management has always left to his discretion how much or how little he could reveal of C-H practices.

"Generally, we've gained materially by such informal meetings," Jerry said. As for technical shows, Jerry feels they are fine, but he gets "more out of talk with people in a hotel room after the show closes."

What are some of things wrong with the industry, we asked him. His answer: "Not enough basic knowledge among companies who buy resistance welding equipment to realize the difference between bad and good . . . many cannot judge value except by price . . . more often than we think, this dollar tag does not indicate true value of the machine."

Jerry, who will be 70 this fall, will continue to live in Milwaukee in retirement. This summer — as in the past years — he vacationed with his wife at their cottage on Big Cedar Lake, near West Bend, Wis. The Welches have a married son and a married daughter and five granddaughters.

Because of a heart attack he suffered last year, Jerry plans to take it easy in retirement — at least for a few months. But we wouldn't be too surprised to see him back in the industry — at least in an advisory capacity.

He has much to offer.

For more information, fold out Welding Info-Aid card on page 91 and circle appropriate numbers as you read.

45 NEW PRODUCTS for you

Arc welder uses electrode wire as small as 0.025-in. diameter

MiniArc arc welder uses electrode wire as small as 0.025-in. diameter. Semiautomatic unit uses carbon dioxide and argon-carbon dioxide mixtures in addition to argon or helium. Unit welds light-gage metals in any position. Equipment consists of AM-8 torch, WC-5 control with wire drive, interconnecting gas and flexible conduit assemblies. The 12¼-in. by 16-in. by 20-in. unit has a wire feed rate from 55 to 500 ipm. Wire sizes are 0.025, 0.030 and 0.035 in. **National Cylinder Gas Div.**

Circle No. 1 on Info-Aid Card.

Flux designed for welding manganese steel

Agglomerated alloy flux is designed for submerged arc welding or rebuilding 12-15% manganese steel. M-210 flux produces weld metal deposits with a yield strength of 64,400 psi, an ultimate strength of 107,500 psi, and an elongation in 2 in. of 35%. **The Lincoln Electric Co.**

Circle No. 2 on Info-Aid Card.

Spot surface thermometer has range up to 1,004 F

Spot surface thermometer has range to 1,004 F. Stainless steel unit can be used on any surface. Thermometer is placed on surface and in 60 seconds exact temperature can be easily read. It is also useful in measuring ambient temperatures in furnaces, ovens and other enclosed spaces as well as in non-corros-vee liquids and gases. Alnico magnetic clip makes possible use of thermometer on non-horizontal ferrous surfaces. Auxiliary pointers record minimum and maximum temperatures during measuring period. **Pacific Transducer Corp.**

Circle No. 3 on Info-Aid Card.

Neutron generator useful for radiography

Designed for fundamental research, isotope production and energy level determinations, 14 MeV neutron generator is useful for isotope activation and radiography. Powered by stabilized 125 kv source, generator produces continuous mono-energetic 14 MeV neutron flux of 10^8 neutrons per second and a pulsed 14 MeV flux of 10^9 to 10^{10} neutrons per second by the d-t reaction. **Philips Electronic Instruments.**

Circle No. 4 on Info-Aid Card.

E7018 electrode welds steel in all positions

E7018 iron powder low hydrogen electrode is designed for all position welding of steel. Easyarc 328 can be used with a-c or d-c reverse polarity. Electrode available in 14-in. lengths and 3/32-in., 1/8-in., 5/32-in. and 3/16-in. diameter. **Air Reduction Sales Co.**

Circle No. 5 on Info-Aid Card.

Three-phase gun welds stainless steels

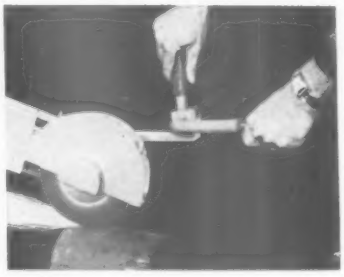
Three-phase portable gun with 5-ft throat depth and components for spot and roll spot welding is designed for welding stainless steel alloys. Gun will handle work thicknesses from 0.001 to 0.125 in. Throat height is 18 in. and will attain maximum forging pressure of 4,000 lb. **Progressive Welder and Machine Co.**

Circle No. 6 on Info-Aid Card.

Electron beam welder joins reactive metals

Model VX-20-30-40 electron beam welder joins refractory and reactive metals as well as dissimilar metals. Vacuum chamber is 20-in. wide by 30-in. high by 48-in. long. Gun has traverse, vertical motion and longitudinal motion. Vacuum chamber can be pumped to 1 by 10-4mm Hg in about 4 minutes. **Sciaky Bros., Inc.**

Circle No. 7 on Info-Aid Card.



Swing frame grinder takes 7 to 10-in. wheels

Swing frame grinder will accommodate 7-in. and 10-in. diameter wheels with 1-in. face width by 1-in. bore. Unit is powered by 5 hp, 3,600 rpm motor to drive resinoid wheels at 9,500 sfpm **Grinding & Polishing Machinery Corp.**

Circle No. 8 on Info-Aid Card.

Machine handles pipe cleaning, tape wrapping

Pipe cleaning and tape wrapping machine uses twisted wire wheel brushes revolving at high speed. Unit uses one head, handles pipe from 3 in. to 6 in. **Crose-Perrault Equipment Corp.**

Circle No. 9 on Info-Aid Card.

Weldable strain gages give stability to 750 F

Weldable strain gages provide stability from cryogenic through 750-F temperatures. Small gages are fully stabilized by heat-treating. Available in phenolic-bonded Constantan foil for temperatures to 500 F and ceramic-bonded Nichrome V foil for temperatures to 750 F continuous or 1,000 F short term. **Electronics & Instrumentation Div., Baldwin-Lima-Hamilton Corp.**

Circle No. 10 on Info-Aid Card.

Portable 180-amp welder weighs only 65 lb

One-cubic-ft a-c welder weighing 65 lb gives six steps of heat from 60 to 180 amp. Welder is offered only as a ready-to-use kit, complete with electrode cable holder, ground cable with clamp, welding helmet, wall outlet, and package of electrodes. Operating on 230 volts, 50 or 60 cycle, single-phase current with full 37-amp input load, the Compact has 70-volt open circuit permitting use of low hydrogen and stainless steel electrodes up to 3/16 in. **Harnischfeger Corp.**

Circle No. 11 on Info-Aid Card.

NOW! TWO NEW ECONOMY RODS for easier, speedier hard facing

Coast No. 192 W (57-62 RC, as deposited)

Coast No. 196 W { 45 55 RC, as deposited) Work hardens to 55-60 RC)

Designed to save you time and effort in hard facing, these are the forerunners of an entire line of improved Coast Metals rods.

Their new extruded coatings—result of more than two years of research—provide extremely high deposit rates and make for real ease of welding under all conditions. You can strike the arc readily—hold a long or short arc, as the job demands—position weld with perfect ease. Beads build up nicely, too, and are clean and smooth—require less finishing.

Use Coast No. 192 W for such work as surfacing crushing and grinding machinery, where abrasion is severe.

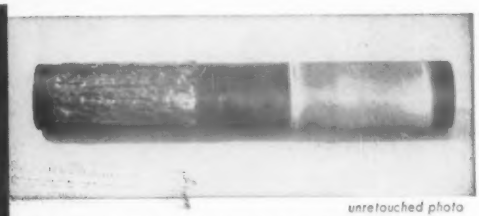
Use Coast No. 196 W for resistance to both abrasion and impact in overlaying large areas, for example, on earth moving, dredging and mining equipment.

Write for complete information.

COAST METALS, INC.
Little Ferry, N.J.
Coast Metals Canada (Ltd.), Hamilton, Ont.

How flame spraying can pay for itself in your shop in a very short time

ONE EXAMPLE
Hard facing time cut from 4 hours to 25 minutes



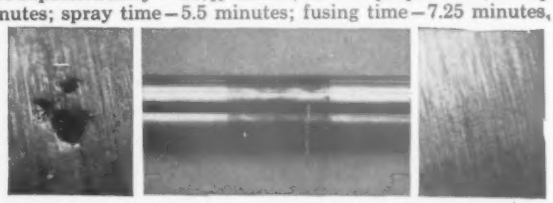
unretouched photo

The two end sections of this shaft have been built up with AMS 4775. Section at left applied by welding – time 4 hours; section at right by flame spraying – time 24 minutes, 45 seconds.

QUESTION: Look at the picture. Which end would you prefer to grind finish?

Here's the whole story. We took a 15" length of 2.5" mild steel shafting and undercut two 5" sections .050" on the radius. We then sent the shaft to a nationally-known job shop with instructions to apply AMS 4775 on the left-hand section, sufficient to finish at 2.5". Weight of welded-on alloy was 17 9/16 ounces – time spent by one of their top men – 4 hours (including preparation).

Then we blasted the second section with steel grit and flame sprayed it with AMS 4775 in powder form (ThermoSpray Powder 15E). The coating was then torch-fused. Weight of deposited alloy – 11 5/16 ounces; surface preparation, set-up and pre-heat – 12 minutes; spray time – 5.5 minutes; fusing time – 7.25 minutes.



Unretouched photo, in center, shows finish-ground shaft. Insets, magnified about 50X, show pits in welded section (left) and no pits in flame sprayed section at right.

We then sent the shaft out to a grinding shop with instructions to clean up at 2.500" plus. The flame-sprayed section cleaned up at 2.510" but welded section still showed pits when grinding was stopped at 2.477" Rockwell of welded end Rc-61, sprayed end Rc-60.

Pump plunger being flame sprayed with METCO ThermoSpray® Powder Gun

These flame-sprayed coatings are solid, homogeneous; usually superior to those applied by other methods. You can apply them at high speed, with lower material and finishing costs. In addition to AMS 4775, a number of other powders – including tungsten carbides – are available for various service requirements; all may be fused–some used as sprayed for certain service requirements.

For further information on this high-speed, money-saving, hard-facing process, phone, write or wire.

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Eye, head protectors snap onto headgear

All-purpose combination of standard head and eye protection units snap onto specially designed headgear. Satellite unit offers lightweight plastic headgear adjustable in quarter sizes from 6½ to 8 head size. Molded brow shield has replaceable plastic-foam and brow-cushion. Shields for unit include 8-in. by 17-in. unbound plastic window; 6-in. or 8-in. brass screen window; 4-in., 6-in. or 8-in. bound plastic window; standard chiporweld eye shield and seamless welding-front with rubber lens holder. **Dockson Corp.**

Circle No. 12 on Info-Aid Card.

Cutting torches feature new oxygen valve

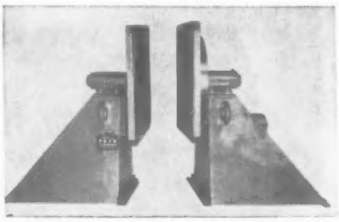
Complete line of machine cutting torches features oxygen valve which provides unrestricted fullflow with a three-quarter turn. Valve has quadruple thread for fast action and smooth control of cutting jet. No. E-97-C valve has self-lubricated O-ring packing. **The Harris Calorific Co.**

Circle No. 13 on Info-Aid Card.

Profile cutter can be attached quickly

Profile cutting attachment for P-model machines can be installed or removed in minutes. Cutter is designed for duplicating any shape from a template, or cutting circles, rectangles, square holes, slots, rings and hole punching. Attachment moves in any direction on ball bearings. **American Pullmax Co., Inc.**

Circle No. 14 on Info-Aid Card.



Head, tailstock units have 32,000-lb capacity

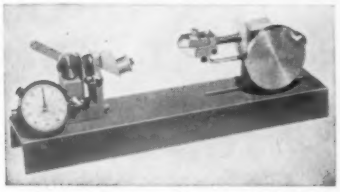
Line of head and tailstock units range in capacity from 5,000 lb to 32,000 lb. These are heavy-duty units with machined gear train and anti-friction bearings. Tee slots and a pilot bore in the table center aid in quick alignment and clamping of work. **Cecil C. Peck Co.**

Circle No. 15 on Info-Aid Card.

High-speed grinders are small, light, quiet

Series 15 air-driven lightweight high-speed grinders are 16⅝-in. to 18-in. long, weigh 6½ to 7¼ lb. Grinders have free speeds of 6,000, 9,000, 12,000, 15,000 rpm. Choice of grip or straight handles and thumb or lever throttles provides easy handling. Closed-face wheel guard included. Muffler design keeps operation about 15 decibels quieter. **Ingersoll-Rand Co.**

Circle No. 16 on Info-Aid Card.



Tensile testers have range to 100 lb

Weld joint tensile testers are designed for use in developing weld schedules in high-density electronic component packaging and statistical quality control of production welding. Model VTA-46 has range of 0 to 50 lb. VTA-47 has 0 to 100-lb range. Both feature load indicator which holds maximum specimen pull until reset. **Hughes Aircraft Co.**

Circle No. 17 on Info-Aid Card.

Plasma unit generates 30,000 F temperatures

Plasma equipment can generate temperatures of 30,000 F. Unit can spray coatings of any material with a melting point. Unit is small and light. Controls for torch, power supply and spraying device are automatic and simple. Torch can cut, weld, heat treat, spray. **Precise Metal Products Corp.**

Circle No. 18 on Info-Aid Card.

Gas gouging nozzles make fast starts

Two-piece gouging nozzles are designed for use with natural gas and propane. Ideal for gouging heavily-scaled or rusted plate, or castings with sand incrustations. Gouging starts have been obtained in 4 seconds. Oxweld 1542 Series incorporates slotted internal nozzle with external sleeve. **Linde Co.**

Circle No. 19 on Info-Aid Card.

TUFFALOY forged seam welder wheels provide the utmost in conductivity and long life. Photo by Taylor-Winfield Corporation.

TUFFALOY FORGINGS

Fault-Free and Right on Spec

To carry the current they should and withstand the pressure they must, resistance welding alloy parts have to be right on specification both as to composition and structure.

RWMA specification forgings by TUFFALOY are used for seam welder wheels and shafts, butt and flash welder dies, and welding platens. TUFFALOY's more than twenty-five years in producing these forgings have led to the establishment of the largest stock of forged bars and wheels anywhere.

For fault-free forgings—wheels (finished or unfinished), square or rectangular bars, and special shapes of all kinds, all heat-treated or cold-worked to maximum hardness, specify TUFFALOY.

TUFFALOY alloys are semi-continuously cast into twenty-foot long billets for greater uniformity of structure.

Forging the desired shapes from heated segments of TUFFALOY billet under a steam hammer takes rare old-world skill.

Doc Tuffy says . . . to make sure every TUFFALOY forging meets hardness requirements, every forging is tested individually. TUFFALOY people will always go a step further to maintain product superiority.

Write or call your nearest AIRCO or TUFFALOY distributor. Ask whether your forging needs are now in stock. Ask him too for the TUFFALOY catalog . . . it makes correct alloy and tip specifications easy.

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WORLDS LEADING WELD CLEANING TOOLS

for the welder who thinks he has everything!

NEW! "SUPER" TOMAHAWKS

Get these SUPER features in the new "SUPER"!

1 Redistribution of weight—The weight's in the head for more production with less effort.

2 New light weight, tempered aircraft aluminum shaft. Unbendable — unbreakable. Can't turn or come loose.

3 New Atlas "wide-blade" design. Wider chipping edge further increases chipping speed — adds to life of tool.

4 Formed hardwood grip that fits the hand. Locked on shaft so it can't turn or loosen.

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33 MODELS

Each Atlas tool is made as well as we know how. Ask your welding supply dealer to show you the complete line.

ATLAS WELDING ACCESSORIES INCORPORATED
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FERNDALE 20, MICH.

Spot welder provides 6 to 330-lb pressure

M 33 VP press-type bench spot welder allows fingertip adjustment of welding pressure from 6 to 330 lb. Unit provides 162 current settings from 900 to 16,000 amp by vernier regulator. Watercooled welder can be air or foot operated. **Aro Spot Welder Corp.**

Circle No. 20 on Info-Aid Card.

Strip material fights metal wear, corrosion

Rectangular metal strip material for wear plate service combats metal wear, corrosion, abrasion and fatigue in machine components. Rectangles come in two alloys with high elastic limits. Rectangles are supplied in mill or cut lengths or stock sizes from ¼-in. by 1-in. to 3-in. by 3-in. **Ampco Metal, Inc.**

Circle No. 21 on Info-Aid Card.

Punch press features new gaging system

Fabricator is single-station high-speed punch press capable of punching round and shaped holes, notching corners, radii and vees, and nibbling straight line or contour patterns. A new gaging system consists of a 1¼-in. holder with micro-set gaging that allows any operator to make back and end gage settings directly to thousandths of an inch in matter of seconds. **Wales Strippit Inc.**

Circle No. 22 on Info-Aid Card.

Centrifugal unit casts babbitted metal

Semi-automatic unit deposits babbit bearing material in steel tube while tube is being heated. Operator places fluxed tube on spindle adapter. Rotating pop-up fixture sets part in proper relation to inductor coil. Babbit shot released from hopper passes through spindle shaft into tube. Internal plug holds shot. Heating cycle starts and continues 17 seconds at 400 F uniform temperature. Rotation is continued at about 1,000 rpm. Water quenches, sets and forms bearing in place. **Induction Heating Corp.**

Circle No. 23 on Info-Aid Card.

Welding gloves are chemically treated

Chemically-treated fabric of welding gloves gives longer life. Fire-resistant gloves are 18 ounce 100% cotton fabric. Gloves are ideal for welding, heat treating and other hot metal work where flash, flame and sparks are present. **Bestos Glove Co.**

Circle No. 24 on Info-Aid Card.

Dial-operated bender permits angle programing

Dial-A-Bend device is an electronic angle-of-bend selector designed to promote profitable handling of bending requiring frequent setup and changeover. From specifications and records even an untrained operator can program bends with this unit. Compensator dials allow quick adjustment for material springback variation. Printed records of dial settings are easy to store. **Pines Engineering Co., Inc.**

Circle No. 25 on Info-Aid Card.

Device removes moisture from compressed air lines

Automatic Moisture Minder positively and continuously eliminates water condensation from compressed air lines with no loss of air pressure or line drop. Device can be added to present system in minutes without cutting lines. If you use filters, device drains them continuously. If you do not use them, the device eliminates need for manual draining of moisture. **Barger Mfg. Co., Inc.**

Circle No. 26 on Info-Aid Card.

Weldor's square eases layout, cutting

Weldor's layout and cutting square eliminates C clamps and cutting guides. Made of 1/8-in. solid brass, the blade is 18-in. long. Three 20-lb magnets in cast aluminum frame hold the Combo square firmly. Cutting tip is simply placed along spatter-proof blade and cutting is done off of plate. Floating bar allows magnet contact on flat surfaces. **Tod-O Mfg. Co.**

Circle No. 27 on Info-Aid Card.

Pipe rotator handles up to 5-in. pipe

Pipe rotator is built for use on up to 5-in. pipe for machine, manual down-hand, or semiautomatic squirt welding. Rotating speeds are variable from 7 to 14 ipm. Less than 200 lb, unit can be used on bench or supported on floor-mounted stand. **Cecil C. Peck Co.**

Circle No. 28 on Info-Aid Card.

Filters designed for welders, X-ray units

Power line filters are designed for industrial electrical equipment such as welders, X-ray equipment. Model D-60 has the following characteristics: 50 amp at 250 volts a-c 400 cps; 60 amp at 250 volts a-c 60 cps; 70 amp at 600 volts d-c and 100 db plus from 100 kc to 45 kmc. **McMillan Industrial Corp.**

Circle No. 29 on Info-Aid Card.

Helium detector permits quick leak location

Dual-range detector permits quick, precise location of helium leaks in tanks, piping and other fittings. Unit is powered with mercury cells for long battery life. Model HDL has hand-pumped rubber aspirator bulb for use where no 115-volt a-c is available. HDLP has small 115-volt a-c vibrating reed pump for drawing gas for scanning. **Industrial Instruments, Inc.**

Circle No. 30 on Info-Aid Card.

Circle No. 170 on Welding Info-Aid Card

STULZ MANGANESE-XL
WELDING ELECTRODES

The Finest Available!

STULZ MANGANESE-XL

For high-strength joining of dissimilar carbon and alloy steels. Excellent shock resistance. Porosity free. Easily cut by oxy-acetylene. Good vertical welding. Low hydrogen. Austenitic manganese-nickel analysis.

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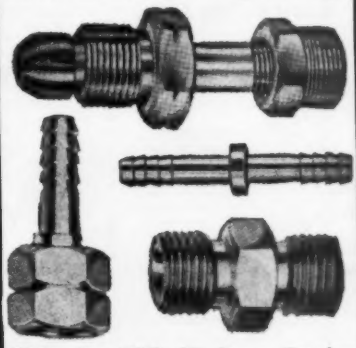
For HIGH QUALITY and LOW COST Welding Fittings



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Welding Equipment Co.
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Circle No. 171 on Welding Info-Aid Card

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SuperGrip®

GROUND
CLAMPS

Model L—500 Amps.

Model M—300 Amps.

Model S—200 Amps.

Quick and "handy" grounding speeds up the welding job and a positive connection saves welding power to produce more welding work per day. These new *SuperGrip* GROUND CLAMPS were designed by the industry's most experienced manufacturer of welding and safety equipment.

check these outstanding features:

EXTENDED LOWER LIP for easy clamping with quick "under and on" motion.

BALL POINT SET SCREW of "man size" diameter grips cable tightly for full cross-section connection.

CABLE SUPPORT LIP offers added wrap area to minimize strand breakage.

POWERFUL COMPRESSION of spring gives maximum "bite"... with spring fully insulated from grips.

BROAD, FLAT BASE JAW and heavy teeth offer large contact area for positive connection.

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or write for Bulletin No. T2-R

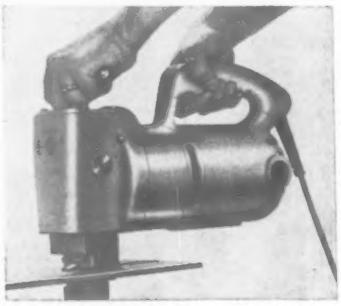
The FIBRE-METAL Products Company | CHESTER PENNA

In CANADA: Fibre-Metal (Canada) Limited, Toronto

Safety glasses have clear sideshields

Safety glasses have flat, half-type clear or green plastic sideshields. Sideshields are cemented to temples and fit spatula or plastic-cable styles. SG-245 sideshield is clear model, SG-256 is green. **Willson Products Div.**

Circle No. 31 on Info-Aid Card.



Unit will cut ¼-in. carbon 7/32-in. stainless

Modern Gobbler will cut ¼-in. carbon steel, 7/32-in. stainless steel, and 3/8-in. aluminum. Variable torque allows variable strokes for different thicknesses. SN-40 has carbide die, built-in lubricator and circuit breaker. **Modern Mfg. Co., Inc.**

Circle No. 32 on Info-Aid Card.

Decoiling, cut-to-length machines are automatic

Line of automatic decoiling and cut-to-length machines includes coil reel, straightener or leveler measuring unit, hump table, shear and conveyor unit. Available in various capacities with maximum sheet thickness of 3/16 in. and 72-in. wide. Cut length accuracy of ±0.008 in. can be provided. **Lennox Tool & Machine Builders.**

Circle No. 33 on Info-Aid Card.

Air-pressure sprays anti-spatter compound

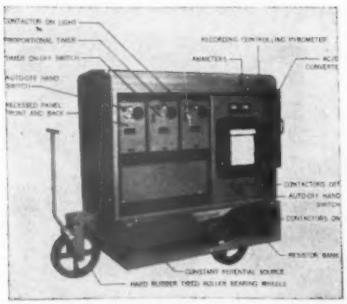
Sure Shot portable sprayers spray anti-spatter compound. Air-charged by standard compressed air chucks or auxiliary carbon dioxide bombs, sprayers dispense anti-spatter compound and other light liquids in a jet stream of fine mist spray. **Milwaukee Sprayer Mfg. Co.**

Circle No. 34 on Info-Aid Card.

Epoxy adhesive cures in 60 seconds

Minit-Cure epoxy adhesive cures in 60 seconds at room temperature and can be accelerated to 45 seconds with infra-red heat. Resin-hardener adhesive system is ideal for automatic meter-mixing-dispensing units in rapid production line work which may eliminate soldering operations. Adhesive bonds metal to metal, plastic to plastic and various other surfaces. **Allaco Products.**

Circle No. 35 on Info-Aid Card.



Portable unit welds, can stress relieve

Portable machine can be used to stress relieve up to 12 welds and to do a-c/d-c welding. UniPak units can stress relieve 12 welds at one time in 3-in.-diameter pipe and 6 welds at a time in 6-in.-diameter pipe. Since resistance heating is used, maximum pipe wall thickness for programmed heating is about 3/8 to ½ in. **Electric Arc, Inc.**

Circle No. 36 on Info-Aid Card.

Layout tool offers accuracy to ±0.005 in.

Layout tool offering ±0.005-in. accuracy is designed for scribing straight lines or circles. Setting points is accomplished by ¼-in. adjustment on locating rod and final setting to fine adjustment with micrometer-type wheel on bar. One complete wheel turn equals 1/16-in. travel. Once final setting established, lever lock holds setting till released. Available in 12-in., 18-in. and 24-in. rod sizes. **O'Brien Engineering Co.**

Circle No. 37 on Info-Aid Card.

Abrasive belt grinder is foot operated

Abrasive belt grinder for spot grinding has foot treadle operation permitting use of both hands to position work piece. Machine, mounted on floor column, provides 12 in. of vertical motion using the foot treadle. A 7½-hp totally-enclosed fan-cooled ball-bearing motor drives a 3-in. wide by 132-in. long belt. **Grinding and Polishing Machinery Corp.**

Circle No. 38 on Info-Aid Card.

Toggle-action pliers give 1,600-lb force

Toggle-action pliers are designed to apply a 1,600-lb clamping force with normal hand pressure. P-1600 is available with 2¼-in. throat gap and 1 3/16-in., 3-in., 4-in., and 6-in. throat gap. Pliers are made from heat-treated and cadmium-plated steel forgings. **Lapeer Mfg. Co.**

Circle No. 39 on Info-Aid Card.

Welding torch has large valve opening

Large opening valves are now standard on No. 43 welding torch. Nylatron valves with large openings permit sufficient volume for wide welding and heating range. Continuous spring tension on valve stem assembly makes flame adjustment on small tips easy and assures constant flame setting. **The Harris Calorific Co.**

Circle No. 40 on Info-Aid Card.

Selenium rectifier has higher current ratings

Mark V selenium rectifier is reported to give current ratings up to three times those of comparable-sized standard selenium cells and stacks. Rectifier is designed primarily for low-voltage high-current applications. **Syntron Co.**

Circle No. 41 on Info-Aid Card.

Respirator guards against organic vapors, paint

C-251 respirator gives protection against paint sprays, vapors, enamels and lacquers. Single-cartridge replaceable filter respirator is approved by the U.S. Bureau of Mines. **Pulmosan Safety Equipment Corp.**

Circle No. 42 on Info-Aid Card.

Kit designed for training plastics weldors

Model 15-TM kit is designed especially for training weldors and for maintenance and repair of plastic-fabricated products. Kit includes plastics welder, aluminum welder stand, round welding tip, tack-welding tip, 16-ft neoprene air hose with cord, practice pieces, and instruction manual, all in steel carrying case. **Kamweld Products Co.**

Circle No. 43 on Info-Aid Card.

Foot-operated clamp holds bandsaw blades

Foot-operated clamp holds bandsaw blades while dressing newly-completed weld. Filing clamp holds band saw blades up to 2-in. wide while extruded metal is filed from weld joint. Light foot pressure opens clamp for insertion or removal. A 1,000-lb spring gives holding pressure and exerts tensile pull similar to band saw machine. **Stryco Mfg. Co.**

Circle No. 44 on Info-Aid Card.

Circle No. 170 on Welding Info-Aid Card

STULZ UNIVERSAL HARDFACE WELDING ELECTRODES

The Finest Available!

STULZ UNIVERSAL HARDFACE

Reduces need for inventory of a variety of hardfacing. All-purpose electrode used in heavy industry and mining where varying conditions of abrasion, impact and metal-to-metal wear occur. Rapidly self-hardens up to 53 R.C. Low hydrogen type. Forgeable. AC-DC

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Farm maintenance welder has 25 to 250-amp range

General utility farm maintenance welder is designed for rough use. Welder will also cut mild and stainless steels, cast iron, aluminum and other sheet metals. Switch converts from a-c to d-c. Range is 25 to 250-amp a-c, 20 to 200 amp d-c. Running gear on 10-in. wheels is available. **Westinghouse Electric Corp.**

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Repair compound is 80% bronze, 20% plastic

Repair compound consists of 80% bronze and 20% plastic. Devcon BR has been successfully field tested by foundries for filling large blow holes and other imperfections in bronze and brass castings. Compound is simply mixed with hardening agent and applied to bond iron, bronze, steel, aluminum, brass, wood, glass and many other surfaces. **Devcon Corp.**

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Cutting tips operate on natural gas

Low-pressure natural gas cutting tips are designed for cleaner cutting of thin-plate steel. Series 6290 NX tips are available in three sizes: OOONX, OONX and ONX. **The Harris Calorific Co.**

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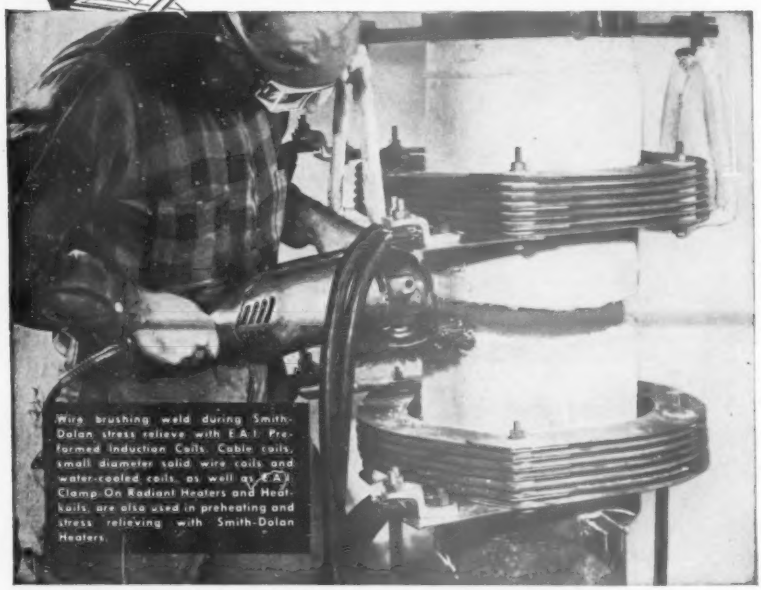

Wire brushing weld during Smith-Dolan stress relieve with E.A.I. Pre-formed Induction Coils. Cable coils, small diameter solid wire coils and water-cooled coils, as well as E.A.I. Clamp-On Radiant Heaters and Heat-coils, are also used in preheating and stress relieving with Smith-Dolan Heaters.

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Bending presses have 30, 40-ton capacity

Model 30-T bending press gives good quality bends on work up to 3-in. OD to 0.125-in-wall steel tubing. Model 40T handles work with heavier walls and in larger diameters. Production speeds up to 800 bends per hr can be attained. Capacity of 30T model is 30 tons. 40T has 40-ton capacity. **Pines Engineering Co., Inc.**

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Rectifier panel meters designed for a-c/d-c work

Rectifier-type panel instruments come in complete rating and size range to meet measurement applications requiring a-c to d-c conversion. Instruments permit a-c measurement with 20-25% less resistance than a-c moving-iron instruments, according to manufacturer. Each meter has self-shielded core-magnet mechanism. **General Electric Co.**

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CD Cement 350 is permanently flexible general purpose adhesive. The product bonds natural and synthetic rubber, vinyl plastic, fabric, leather, and wood to itself or to glass, steel, iron, aluminum, phenolic plastic and other surfaces. Adhesive is fast setting, waterproof. **Chemical Development Corp.**

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Multi-purpose pyrometer has three scales

Pyrometer with three scales can be used with almost all base-metal thermocouples and as a sensitive millivolt meter for non-pyrometric applications. Scales, 3½-in. long, are: 32 to 2,400 F; 32 to 2,530 F; and 0 to 50 millivolts. Fahrenheit-Centigrade conversion table is included. **Edmund Scientific Co.**

Circle No. 61 on Info-Aid Card.

Mig power supply operates single phase

Mig power supply operates on single-phase lines and gives 200-amp d-c constant voltage. Model CV200 has 100% duty cycle and 8.5 to 53-volts d-c open circuit output range on 230/460-volt input. Unit suited for Mig welding steel, aluminum or alloys including short arc and spray arc. **Glenn Pacific Corp.**

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Centerless grinder grinds multiple diameter parts

Centerless grinder has permanently-mounted crush dresser for thrufeed, plunge feed and infeed. Model CG-12, 24 in. by 48 in. including coolant tank, grinds multiple diameter parts and intricately-shaped profiles and materials such as tungsten carbide, stainless or carbon steel, glass or plastic to 0.0002 in. or 6 to 8-micro finish. It also grinds wood, non-ferrous metals, fibre, hard rubber, ceramics and cork. **Royal Master Grinders, Inc.**

Circle No. 63 on Info-Aid Card.

Billet wheels grind stainless steels

Heavy-duty billet wheels are designed principally for grinding stainless and other special alloy steels. Hot-pressed resinoid billet wheels can be used with high-speed heads which operate at 12,500 sfpm. Cold-pressed billet wheels for grinding steel are designed for swing frame grinders. The **Carborundum Co.**

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ARE TOO MANY NOT ENOUGH?

We frequently hear it said that there are too many welding shows. On the surface, the welding equipment manufacturer is inclined to agree as he views the frequent requests for exhibits and displays.

To determine whether this is true or not requires an interpretation of the purpose of the "welding show."

Welding, while being the most important metal fabrication process of our generation, has had no better than stepchild treatment from an educational standpoint. Then too, at times the process has been controlled by a few companies and a lot of commercial nonsense has been dished out that has held back real progress. I believe that the full, beneficial exploitation of welding is still in its infancy and only by acquainting the user with the new processes and *showing* him how the new equipment can do his job will we advance.

Although we have a number of excellent college courses training professional welding engineers, only meager amounts of this education reaches the practical user. Our schools at the secondary and vocational levels are doing little to teach welding and, if it is taught, much of the instruction is outmoded since the teachers are generally unable to keep up with the latest advances in the art.

Our "welding shows" should turn away from the path of big display booths, big signs, glamor girls and other attention-getting gimmicks. Instead of catering to the few who can attend the AWS and NWSA sponsored events, we should concentrate on the idea of directly teaching the user to appreciate the vast potential of the welding process. We should show him what the new equipment can and cannot do, with greater emphasis on the use of welding as a tool. We can, and should, help the workman to this knowledge.

Is this the responsibility of any one group or of all of us? I think all of us must do our share. We as a manufacturer of welders have recently put into service a large van-type truck equipped with the most advanced equipment. This truck in its travels throughout the country will enable our trained personnel to actually *show the user* what the various processes can accomplish.

My answer to the question "Are there too many welding shows?" is this: If the purpose of a "welding show" is simply to ballyhoo a company, a machine, or a product, then we do have too many "shows" now. If, however, the purpose is to acquaint the user and the potential user with the latest advances in the field of practical welding technology, then I say we don't have nearly enough.

Niels C. Miller

President

MILLER ELECTRIC MFG. CO.
Appleton, Wisconsin

Our purpose: to define, describe and promote the use of welding and its allied processes in every production and maintenance activity to all phases of industry and business.

Don't be afraid to lose

There is a machine tool and excavating equipment builder in Cleveland (Warner & Swasey) which believes the United States is a good place to live. The firm brings this out in its advertisements.

Although we seldom reprint other editorials, we feel its recent editorial ad merits your consideration and would like to quote it:

"The curse of this age is compromise — too often with evil. So we support neutralist nations with billions for fear they might go communist. We don't dare even whisper a suggestion that they proclaim a stand with the decent nations of the world. If we demanded such a stand, our billions *might* pay off.

"And we let Russia get ahead in the space race, because we were afraid of racketeers who held up production by strikes and featherbedding. We didn't have the courage to risk being tough.

"We can't afford full speed ahead on missiles because powerful pressure groups drain away selfish billions of tax money — groups we should have courage enough to tell go hang.

"*Once* we did have the courage — America was determined with the man-in-space, and had the courage to chance it openly. And courage won.

"Every war to save America was won because our leaders *and* the people pledged our "lives, our fortunes, and our sacred honor" — everything to win. And *then* America won.

"Nothing worth having is ever won by weakly pecking at it, by being afraid of it. We believe the American people will back our President and Government in *risking everything* to preserve freedom — the *American brand* of freedom, not some compromised, watered down foreign version of it. Even if such a stand meant the atom bomb, we earnestly believe all decent, all real Americans would say once more 'give me liberty, or give me death.' Who with a shred of decency left in him, wants to live under enemy-dictated 'co-existence' which is a parlor word today for slavery tomorrow."

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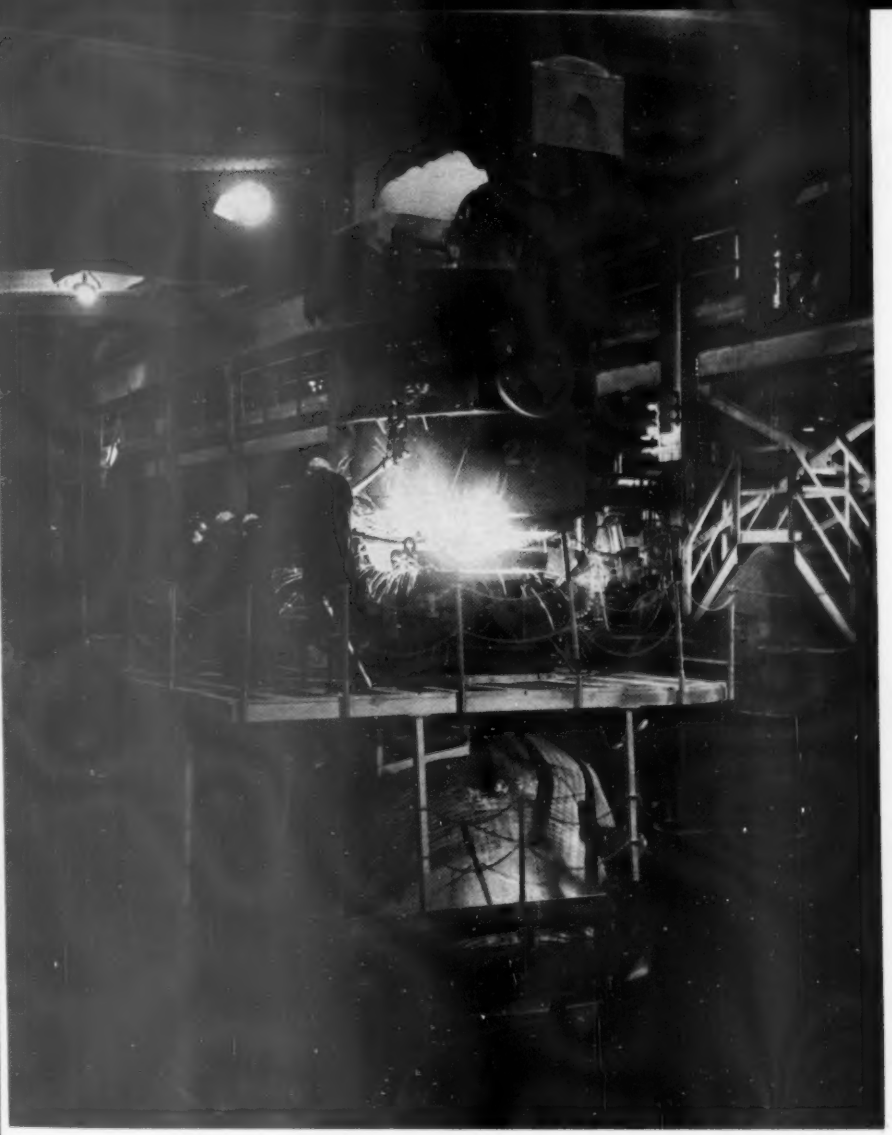


Steelmaker fabricates vacuum degassing tanks

by F. T. Tancula . . . *Editor*

VACUUM DEGASSING processes are designed to produce higher quality steels than result from air melting by open hearth or electric furnace.

The finished degassing tank pictured on the cover, and another just like it, was built for the Lehigh division of Bethlehem Steel Co. by the firm's own Weldment Department. Operation of these units is based on a modification of the Bochumer-Verein process: a heat of molten steel is poured from a ladle to an ingot mold within a vacuum chamber. Hydrogen and other gases are thereby reduced, and the steel is sounder, tougher and cleaner than air cast steel.

The two units were the third and fourth built by the steel producer and differ slightly in design from the first two. Because of shipping limitations, each unit was fabricated in three parts, then assembled at the site — Lehigh's Electric Furnace Melting Department. Each tank weighs about 100 tons.

As shop-fabricated, a top section of one unit consisted of a spun dished head, a truncated

ABOVE — Degassing unit in operation. Molten steel from electric furnace pours from ladle through vacuum chamber into ingot mold. RIGHT — In final stages of fabrication, top section shows (from bottom) flange, water-coolant channel, cylinder, truncated cone, dished head and flanged opening for pouring.

The entire top half of each degassing tank described in the adjoining columns is lined with three layers of 10-gage stainless steel sheets.

Their purpose: to protect, and prolong the life of, the carbon steel shell. One side of the sheets, which are overlapped, is highly polished to provide better heat reflection.

Each layer is positioned on studs previously welded to the wall of the tank's top section. Air spaces separate the first layer from the carbon steel shell and subsequent stainless layers from each other (see photo).

cone of eight welded segments, and a cylinder joined to a bottom flange — all mild steel components.

The dished head was flame-cut, just off center, to take a machined flange opening for pouring. The top section's outside diameter at the cylinder is 17 ft 4 in., and its wall thickness is 2 in., while the cone's is 1½ in. Thickness of the spun head is only 1½ in. — in contrast to the 6-in. flat head used on the earlier design.

The cone consists of four double segments. Each was formed by joining two single sections with automatic multipass submerged-arc welding, with no back chipping. A double-U groove was machined on plate edges. (The shop used a combination of such machined grooves and flame-cut bevels in preparing edges for welding.)

Double segments were welded together manually, using E7018 electrodes. On the inside, work was positioned for flat welding using 3/16-in.-diameter electrode for the root pass, and ¼-in. diameter for the finish. The outside was back chipped and welded vertically using 5/32-in. diameters for root pass and 3/16-in. diameters for the balance.

Current settings were: 150-200 amp at 22-25 volts for the 5/32-in.-diameter electrodes; 200-250 amp at 23-26 volts for the 3/16-in. diameters; and 300-350 amp at 24-27 volts for the ¼ in.

These top section joints were made with multipass automatic submerged-arc welding:

1 — cylinder to flange;
2 — cylinder to cone;
3 — cone to dished head.

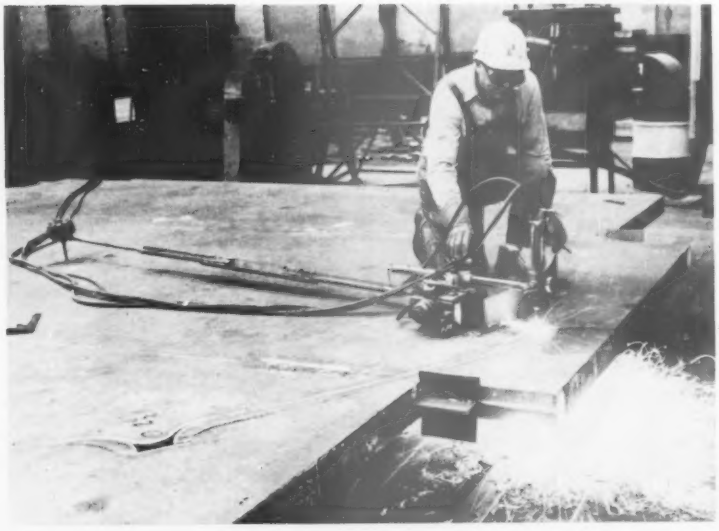
The head was manually welded to the pour opening using E7018 electrodes. This portion was done on the positioner and rotated when necessary. Electrode sizes were 3/16 and ¼-in. diameters. The inside of this seam was welded first; the outside back chipped and welded last.

The cooling channel was also manually welded, again using ¼-in.-diameter E7018s.

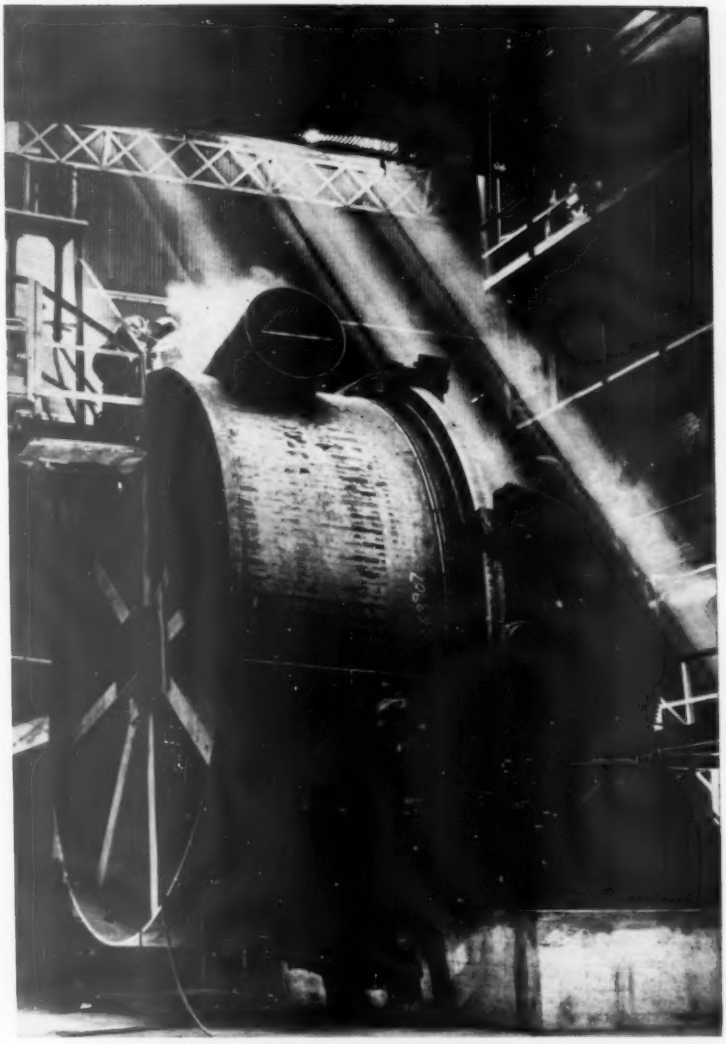
Generally, a 5/32-in. copper-coated mild steel electrode wire was used in all submerged-arc welds with Linde Grade 80 flux (12 x 65). Current range was from 500 to 750 amp at 30 to 34 volts, depending on the pass and plate thickness.

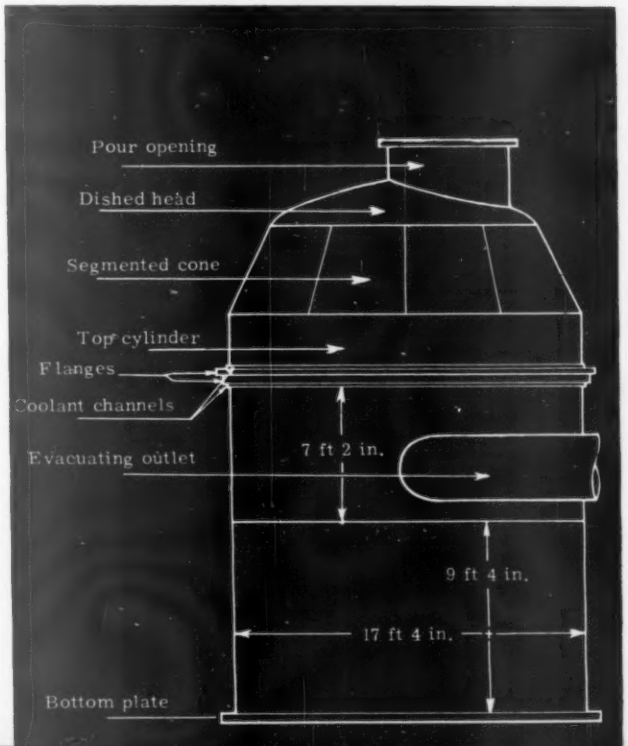
Three manual passes with E7018 low-hydrogen, iron-powder-coated electrodes were made on the inside of most joints.

Cone to dished head and cone



LEFT — Bottom plate was flame-cut, machined with a double-U groove, and submerged-arc welded, then flame-cut to contour. UPPER RIGHT — Evacuating outlet is welded to upper half of bottom section on giant positioner (capacity: 350,000 lb). RIGHT — Line drawing of degassing unit, assembled, but not in operation.





to cylinder welds are made in three manual passes with E7018 electrodes on the inside.

The joint between the 4-in. base and cylinder was welded with submerged-arc inside and out. The outside was back chipped.

The bottom flange of the top section has a machined surface that mates with a similarly machined flange atop the bottom section. In operation, these two are connected by pins and O-rings. The top flange was flame-cut from 4-in. plate, then machined to 3½-in. thick. Its counterpart on the bottom section was machined from 6-in. plate, leaving a 5½-in. thick flange.

Water-coolant channels, formed from rolled angles, were welded to each flange and its respective cylinder wall.

Each degassing tank's bottom section was fabricated in two halves, each rolled from 1½-in. plate. Longitudinal seams were submerged-arc welded.

The upper half was 7 ft 2 in. high, the lower half 9 ft 4 in. A 4-in. bottom plate was welded to the lower half, while the aforementioned 6-in. flange was joined to the top of the upper half. The halves were welded at the Electric Furnace Melting Department site with E6020 electrodes. Each plate edge was double beveled to 45-deg angles. Root opening was 5/32 in.

This final joint and the one connecting the cone and cylinder of the top section were the only welds not stress relieved.

The first degassing tank was spot X-rayed and negatives were clear of porosity and/or cracks. In view of this, it was decided to forego such inspection on subsequent tanks.

All of Bethlehem's hardened steel rolls, steam turbine rotor forgings and generator shaft forgings are now produced from ingots cast in these vacuum degassing chambers. It also uses the process for producing higher quality steel for heavy forgings for other purposes, such as pressure vessels.

Zinc group sponsors tests to set spot welding standards for . . .

ITS HIGH STRENGTH, excellent corrosion resistance and weldability are creating new markets for galvanized steel and expanding old ones. The automotive industry, for instance, has more than doubled its use of the material in the past five years.

Popular though it is with automotive manufacturers, however, galvanized steel has regularly created a serious problem when subjected to the industry's most widely used joining process, resistance spot welding. The problem: variations in thickness of the zinc coating — running as high as 50% on occasion — that cause inconsistent weld quality.

Because the auto industry represents an economically important market, and because auto makers must use spot welding to keep production costs down, the American Zinc Institute has undertaken an intensive research program designed to establish standard spot welding procedures and effective techniques.

AZI's campaign is being guided by a welding committee composed of steel producers, members of the zinc industry and automotive representatives. The program is being carried out by The Budd Co. of Philadelphia.

To gain proper perspective for its study, the welding committee first reviewed both literature and plant practices to determine the latest methods used in fabricating and welding galvanized steel. The group then began an investigation of spot welding electrodes (including materials, geometry and cooling requirements); an evaluation of welding schedules and conditions, and a study of the effects of variations in galvanized steel on electrode life and weld quality.

The committee discovered that control of coating thickness is more of an art than a science — that variations in line speed, pitch, width and depth of roll grooves, and relative alignment make uniform coating thickness an impossibility.

They also noted the additional problem in successfully spot welding galvanized steel that arises from the fact that zinc's melting (786 F) and boiling (1,665 F) temperatures are considerably below the melting temperature of steel (2,700 F). Molten zinc can form a brass alloy on the electrode surface, build up deposits

and, at times, cause stress corrosion cracking in the electrode.

To counter these problems, the committee established an experimental test procedure utilizing galvanized steel of commercial weight — 1.25 oz per sq ft — with minimum spangle and temper. Two thicknesses of material, 0.075 and 0.037 in., were used to determine gage effect. Coating thicknesses ranged from 0.007 to 0.0010 in. on each surface, and there was a difference in weight of 10 to 15% between one surface of the sheet and the other.

Up to 3,000 test welds were performed under each of the many conditions studied, and no maintenance was given any electrode during each run. Electrode life was determined by the first point at which weld quality was unsatisfactory.

Electrode materials tested for comparative performance were copper-cadmium, copper-zirconium, and copper-chromium. All electrode materials showed more consistently reliable welds on the heavier gage steel. Copper-chromium dies had greatest resistance to effects of welding heat. The other two electrode types gave best weld quality, but the copper-cadmium dies evidenced greater wear.

On the basis of the tests, copper-zirconium electrodes were selected for use in all subsequent welding tests.

Electrode geometry was investigated by performing extended test runs on the following tip contours: (1) a truncated cone with 20-deg taper and face diameter of 0.25 in. for 0.037 in. sheet and 0.31 in. for 0.075 in. material; (2) a truncated cone with 45-deg taper and 0.25 or 0.31 in. face diameter; (3) a 2½-in. radius spherical dome, and (4) a hemispherical dome with 5/16-in. radius for 0.037-in. steel and 3/8-in. radius for 0.075-in. steel.

On the thin steel, electrode life of all but the hemispherical-dome die was about the same. The latter lasted three times longer, but surface indentation was excessive and weld strength lower. Welding on the heavier steel resulted in longer life for all electrodes. Truncated-cone contours gave best results.

Problems of alignment and deflection arose when truncated-cone electrodes of 120- to 140-deg included angle were used on portable spot welding equipment.

Further evaluations were thus made of truncated-cone electrodes with a 1-in. radius dome and a face diameter reduced from 0.25 to 0.19 in. These electrodes were very satisfactory on both steel thicknesses, alignment problems were greatly reduced, and there was an approximate 100% increase in the number of satisfac-

Thin coating reduces zinc pickup at Ford

The problem of zinc pickup was solved to a great extent at Ford Motor Co. when Weirton Steel Div. of National Steel Corp. began producing galvanized sheets with thinner zinc coatings on one side.

The sides with the thinnest layer of zinc were those exposed to spot welding electrodes at Ford. As a result of the reduced zinc pickup achieved, Ford has been able to meet its standard of 2,000 welds between electrode tip dressings since Weirton began delivering the special zinc sheets in 1959.

Methods for producing zinc-coated steel sheet

Here are methods currently employed for production of continuous zinc-coated sheet:

Sendzimir: an "annealed in line" process which oxidizes base metal, reduces it in an annealing furnace, passes it through a bath of molten zinc, then cools it.

U. S. Steel: also an "annealed in line" process consisting of chemically or electrolytically cleaning steel strip, annealing it in a non-oxidizing atmosphere, passing it through a coating bath and cooling it.

Cook-Norteman: a process that is "annealed out of line." The sheet steel is annealed before entering the continuous line, then is cleaned, passed through a flux bath, a zinc bath, and is finally cooled.

tory welds before dressing.

The effects of different cooling conditions on electrode life were determined by varying distance of the bottom of the water hole from the electrode face . . . by varying the flow rate of cooling water . . . and by varying welding rates.

In two test setups, the bottom of the water hole was positioned at ¾ in. and at ⅜ in. from the electrode face. In both cases, electrode life and weld quality remained good, but hardness tests indicated lowered mechanical properties in the electrode with the ¾-in. nose distance.

Tests made at flow rates varying between ½ and 1½ gal per minute indicated little or no effect on mechanical properties of electrode material. The tests also established the fact that water flow cannot be used to control electrode life if there is at least an adequate flow consistent with tooling requirements.

Welding speeds influenced thermal conditions of electrodes, so variations in welding rates were studied as part of the cooling conditions. Test runs were conducted at weld rates of 60, 80 and 100 welds per minute, while conditions other than weld rates were kept as constant as possible.

At a critical point, weld quality fell rapidly with the number of welds made. Oscillograph recordings of electrode force showed that, with increased welding speed, weld current was initiated during the period that force was building up. This resulted in "spitting" and burning — probably the main cause of shorter electrode life with high welding rates. For the particular welding conditions in the AZI study, a sharp change in electrode life occurred at approximately 70 welds per minute. This figure, however, may vary under different conditions.

Welding schedules and conditions were tested through extensive investigations of electrode force, weld time and current, and squeeze, hold and off time.

Other welding processes can also be applied to galvanized steel

In addition to resistance spot, butt and flash welding methods, these additional welding processes will perform well on galvanized steel:

Manual Metal-Arc — Use a welding procedure similar to that for uncoated mild steel, but hold electrode high enough to prevent absorption of volatilized zinc by deposited metal, and direct it slightly ahead of the molten pool.

Carbon Arc — Select a filler rod large enough to deposit desired bead width without weaving (i.e., a filler rod about three-fourths the thickness of the sheet metal). Hold filler rod at a 20-deg angle and direct carbon arc to it to protect zinc coating near joint. Use d-c straight polarity. Bronze rods minimize oxidation of zinc coating. (A carbon-arc variation is achieved by laying the rod along the joint and directing a short arc onto it.)

Oxyacetylene — Use a thickly-coated bronze filler rod, or a heavy coat of brazing flux in thick paste form. A neutral flame should be applied directly to a fumeless, deoxidizing filler rod. Use a small tip and, if possible, a jig with jaws close enough to the workpiece to conduct heat away from it.

Three gages of galvanized steel (0.037, 0.060 and 0.075 in.) were investigated to determine influence of sheet thickness on each variable. Comparison was then made with uncoated low-carbon steel sheets. Test results showed that much longer weld times are required for galvanized than for uncoated steel.

Squeeze time was not studied experimentally, but was determined from studies of variations in electrode force.

Various testing methods were tested to determine the merits of each: tensile shear; direct tension; peel; chisel; macro-etch, and visual.

Perhaps the only tests which need explanation are the direct tension test, which involves pulling a U-shaped specimen to failure, and the chisel test, in which a chisel is driven into the interface of a spot welded joint.

The AZI committee found that only the etch test gave excellent results that were truly indicative of weld quality. This test, however, was far from practical for production use. The peel test was thus adjudged satisfactory both from a production and from a good quality control standpoint.

It is the opinion of the AZI welding group that a definite need still exists for developing a test procedure to reliably determine weld quality — and particularly one that may readily be applied in automotive production.

(For a reprint of this article, circle number 248 *on the Welding Info-Aid Card, page* 91.)

New spot unit welds through steel coatings

Designed specifically for use in joining metals with fully-cured or baked-on protective coatings is a new spot welder developed by Cooper Welders, Inc., of Morton Grove, Ill. The machine utilizes two welding transformers, one for each electrode, which provide measured preparatory heating. During this phase, polarity between opposing electrodes is of like sign, so there is no current circulation through the work.

The heating removes the insulating effect of a coating, causing it to become plastic or melt. After preparatory heating, instantaneous reversal of the polarity of one transformer is automatic and true controlled current is established for the spot weld.

DON'T OVERLOOK SHAPES IN YOUR

by **Rex Cleveland**
Kewanee Machinery & Conveyor Co., Kewanee, Ill.

COMPARE MODERN road graders, earth movers, bulldozers, crawler-type tractors and stripping or mining shovels with the same items of 10-15 years ago.

When you do, the trend in heavy equipment design and construction is easily seen: little open structure; little riveting or bolting; rugged, but still simple, design.

Such units cannot be weak, nor look weak. If they are, they will not last; if they do, they will not sell.

This, then, is the epitome of good design and should be the constant aim in every design project — to do the most with the least, and yet make it look like the most.

There are seven basic, rolled mild steel, structural shapes available on a standard production and warehouse basis to the designer of heavy equipment: equal and unequal leg angles; standard and wide flange beams and tees; and channels.

Each is rolled in many sizes, and each size in many section thicknesses too numerous to list. All are generally described by overall dimensions and weight, the latter varying with section thickness.

Figure 1 shows the seven shapes and lists most sizes, but not available weight ranges. Any steel manufacturer's structural shapes data book will detail sizes, sections, weights, and physical and mechanical properties.

These sections are especially valuable where quantity is not great enough to justify die costs for forming or rolling similar sections from strip, bar or plate. Warehouse stocks of these items also make them readily available for either custom building of only a few machines, or test models.

The trick in utilizing these standard shapes is to understand the possibilities and limitations of each section; to stay within the practical usage range of each; and to combine these first two with sound applications of welded assembly.

Structural sections may be used as are all other metal sections — as column members, in compression, as tension members, as torsion members, or as beams. They may be used alone, in combination with other structural members, in combination with bar plate, pipe, tube, etc., or with themselves. Most complex applications are also possible, such as combined use as beams and torsion members.

The principal limitations determining the possibilities of each structural section are physical and mechanical properties, and weldability of the particular design or combination.

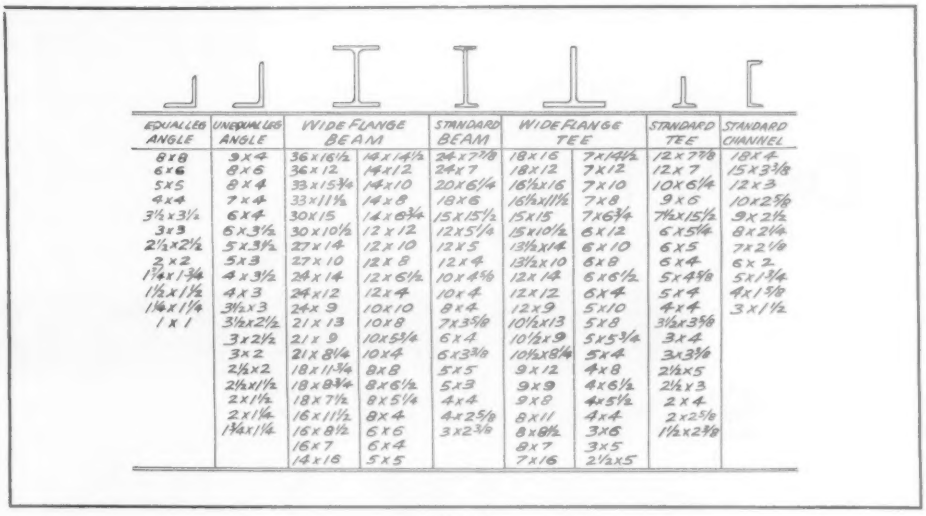
No steel member is stronger than the modulus of elasticity for steel (30,000,000 psi in tension; 11,600,000 psi in torsion) regardless of type or analysis. Most structural sections used today can be classified as mild steel with the following physical properties:

Tension or compression — 60,000
Shear or torsion — 45,000
Elongation — 30%
Brinell hardness — 146

(The first two figures denote ultimate psi strength of mild steel which yields at about 50% of its ultimate strength.)

Using strength formulae which utilize known physical properties, the mechanical properties or possibilities of the section are determined.

These have all been calculated previously for each commonly used section by size, weight or dimension, and can be found in every steel manufacturer's data book, along with diagrams to



EQUAL LEG ANGLE	UNEQUAL LEG ANGLE	WIDE FLANGE BEAM		STANDARD BEAM	WIDE FLANGE TEE		STANDARD TEE	STANDARD CHANNEL
8x8	9x4	36x16½	14x14½	24x7⅞	18x16	7x14½	12x7⅞	18x4
6x6	8x6	36x12	14x12	24x7	18x12	7x12	12x7	15x3⅜
5x5	8x4	33x15⅜	14x10	20x6¼	16½x16	7x10	10x6¼	12x3
4x4	7x4	33x11½	14x8	18x6	16½x11½	7x8	9x6	10x2⅝
3½x3½	6x4	30x15	14x6¾	15x15½	15x15	7x6¾	7½x15½	9x2½
3x3	6x3½	30x10½	12x12	12x5⅛	15x10½	6x12	6x5¼	8x2¼
2½x2½	5x3½	27x14	12x10	12x5	13½x14	6x10	6x5	7x2⅛
2x2	5x3	27x10	12x8	12x4	13½x10	6x8	6x4	6x2
1¾x1¾	4x3½	24x14	12x6½	10x4⅝	12x14	6x6½	5x4⅝	5x1¾
1½x1½	4x3	24x12	12x4	10x4	12x12	6x4	5x4	4x1⅝
1¼x1¼	3½x3	24x9	10x10	8x4	12x9	5x10	4x4	3x1½
1x1	3½x2½	21x13	10x8	7x3⅝	10½x13	5x8	3½x3⅝	
	3x2½	21x9	10x5¾	6x4	10½x9	5x5¾	3x4	
	3x2	21x8¼	10x4	6x3⅜	10½x8¼	5x4	3x3⅜	
	2½x2	18x11¾	8x8	5x5	9x12	4x8	2½x5	
	2½x1½	18x8¾	8x6½	5x3	9x9	4x6½	2½x3	
	2x1½	18x7½	8x5¼	4x4	9x8	4x5½	2x4	
	2x1¼	16x11½	8x4	4x2⅝	8x11	4x4	2x2⅝	
	1¾x1¼	16x8½	6x6	3x2⅜	8x8½	3x6	1½x2⅜	
		16x7	6x4		8x7	3x5		
		14x16	5x5		7x16	2½x5		

FIG. 1

which they are keyed (see **figure 2**). Properties given in each case:

Moment of inertia (I) — the rigidity of the section, or its ability to resist bending.

Section modulus (S) — the strength of the section; its ability to resist failure under tension, compression or shear load.

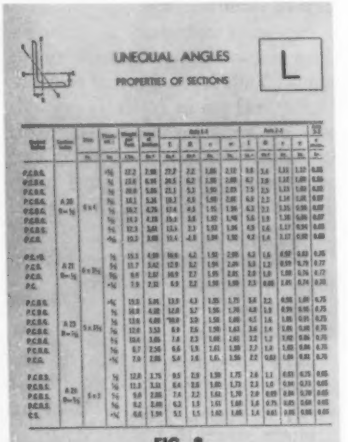


FIG. 2

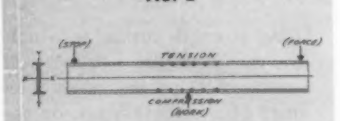


FIG. 3

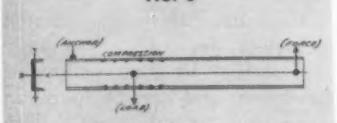


FIG. 4

Radius of gyration (r) — the ability of a section to resist failure in shear produced by turning or twisting.

Thus, a designer must utilize both physical and mechanical properties of a given structural shape to determine the section's usefulness in a specific design problem.

Some are best used as beams, some as columns, others as stiffeners. Observing the uses of familiar sections in existing structures will help acquaint you with standard applications. Sizes are always determined by strength requirements.

Combinations of shapes with each other, or with bar or plate sections, to achieve unusual or more efficient usage will come only as the result of study and imaginative application of the knowledge gained.

The I-beam, as a design member which must assume loads tending to bend it, is generally the most efficient to use among all common shapes.

Here the greatest amount of material in the section is distributed where the heaviest loads will be transmitted. An I-beam, however, must be loaded with force exerted in the same direction as the section's web, since it is comparatively weak at right angles to this axis.

For example, a 12 x 4 x 14# I-beam has a moment of inertia of 88.2 at right angles to axis **x-x,** but only 2.25 at right angles to axis y-y (right angles to the web), a differential of approximately 40 times.

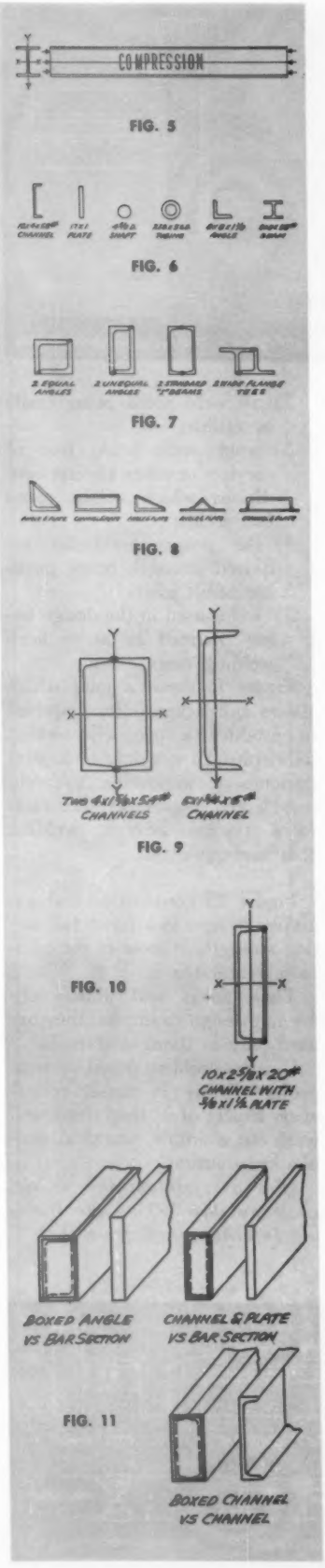
This simply means that this specific shape section has 40 times the ability to resist bending due to the imposition of any load upon it at right angles to axis x-x as it would have at right angles to axis y-y.

Figure 3 shows how the load would influence this shape and illustrates the reason for its relatively great strength when utilized properly.

Channel shapes are likewise much stronger when used with the web resisting the load than when used with the load force exerted at right angles to it (see **figure 4**).

Use channel with the closed side out where it will make the structure appear much heavier than it really is, but first be sure it is heavy enough to do the job. Use angle in much the same way, with the outside on the top and the side.

Tees and angles may also be used as beams, but each with less success due principally to the narrowing gap between moments of inertia on the opposing axis. These sections are more efficiently used in other manners, *e.g.*,



cross-bracing or ribbing to provide rigidity, or for frame openings, etc.

In tabulations of different I-beam sections in any structural shapes data book, note that the greater the depth "d" of the section in proportion to the width "b" of the flange, the greater the moment of inertia of that section at right angles to axis x-x.

Note also that for wide flange I-beams this difference is not quite so great. These shapes are generally just as strong as standard I-beams web-wise, and slightly stronger flange-wise, for any given depth of web section. Such sections are particularly useful as column members to support relatively high loads in compression, whether in vertical, oblique or horizontal positions (see **figure 5**).

Given a choice, and having sufficient space without interference, always pick the I-beam with the slightly thinner web, but greater and much more impressive depth (strength being equal or greater).

No I-beam section has any more value as a tension member than an equivalent section of bar, rod, tube, etc., unless it is being used in an oblique or horizontal position, and must simultaneously support a load, or if extremely long, be self-supporting.

Thus, shape has no influence on ability of a tension member to sustain a given load. Only section area and material count and this applies to all structural shapes (see **figure 6**).

No existing standard structural shapes have very high torsional strength. The radius of gyration of most of these sections is extremely low compared with that of round, oval or square tubular sections.

Wide flange I-beams have higher torsion resisting values in proportion to section area than all other structural shapes, but are still not recommended for this purpose unless they must be used for other reasons.

Until now, discussion has centered on single usage only. In combination with themselves or with other sections, these structural shapes can create the most efficient heavy machinery frames and parts.

There is almost no limit to the possible combinations of standard shapes with other members in practical uses.

Most useful and efficient combinations are those which form hollow sections, although many others may produce very useful design members. **Figure 7** shows several hollow sections formed by combining structural shapes, while **figure 8** shows some possible combinations of shapes and bars or plates.

Practical applications of these hollow sections, or other combinations, depends on knowledge of the mechanical properties of the new sections thus produced, plus an idea of the relative costs and fabrication possibilities.

Besides the one decided advantage of high strength with low weight, all hollow sections also offer the advantages of lesser vertical height, increased resistance to buckling and a greater beam length with the same vertical height.

The hollow section shown in **figure 9** (two 4 x 1 5/8 x 5.4# channels welded flange-to-flange) will have double the moment of inertia about its horizontal axis as its parent section, *i.e.*, 7.6 versus 3.8.

This compares with the moment of inertia of a 5 x 1¾ x 6.7# channel about its horizontal axis, but with a weight savings of 20%. The radius of gyration of this new section will be 3.12, 60% greater than the 1.95 of the first channel.

In addition, the resulting 4 x 3¼ section is more attractive, impressive and lends itself better to joining with other equipment parts of which it is a part. These considerations far outweigh the additional costs of more material plus welding.

Another hollow section with many advantages is a combination of channel and a flat bar as in **figure 10.** Assume the channel is 10 x 2 5/8 x 20# and the flat bar, 3/8 x 9½. The completed section has the outward appearance of a 2 5/8 x 10 solid bar, and

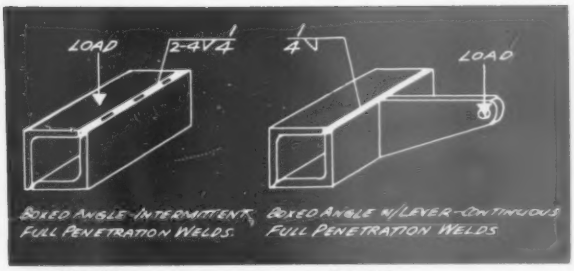


FIG. 12a FIG. 12b

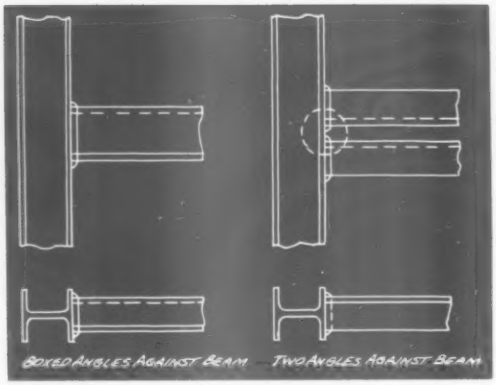


FIG. 13 ►

will join well with other members in assembly. All mechanical properties are increased considerably over that of the parent channel.

Moment of inertia will be about 93.0 versus 78.5 about its horizontal axis, an increase of 18% which will be repeated for all other strength factors.

Figure 11 shows several hollow sections which can be used, with its structural shape counterpart in strength along side.

Note how much more massive and decidedly stronger the hollow sections appear in each case. And remember, given the same section, the total strength of the closed section will always surpass that of its open competitor because of its inherent multi-directional rigidity.

Each combination must be considered on its own merits and its new strength calculations based on combinations of those of the separate members.

All welds must duplicate the strength of the sections being joined, or loss of strength will result. As with any welded structure, no member will be any stronger than its weakest weld.

All welds must also be continuous, if full section strength is desired. Skip or intermittent welds are not satisfactory because if parts are allowed to separate in part, they will react to loads separately and desired strength will not be obtained.

Occasionally, full moment of inertia or radius of gyration, or both, may not be needed. In which case, skip welding may effect considerable savings.

For example, two angles may be combined as in **figure 12a** with intermittent welds, if used as a beam where no torsional loads are involved. If side loads are imposed by a lever (**figure 12b**) full length welding would be necessary. Thus, each application must be judged by itself.

But none of these desired results can be obtained if the planned assembly does not possess weldability — producing a desired joint with a maximum of strength and a minimum of effort and cost.

Thus, weldability can mean many things:

1) **welding the full section of the members being joined at the point of juncture;**
2) **all weld areas being easily accessible;**
3) **weld areas being free of crevices or other adverse conditions which might cause bad welds;**
4) **the proper weld for required strength being possible at all joints;**
5) **welds used in the design being planned so as to keep welding costs down.**

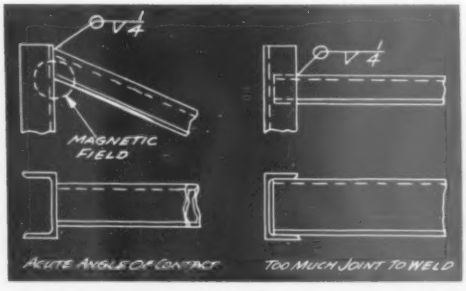
Figure 13 shows a joint which allows full accessibility required to produce a properly welded joint, plus an example of a joint difficult or impossible to weld completely. **Figure 14** illustrates some typical adverse welding conditions to avoid.

Figure 15 contains several examples of how to achieve full section strength in most of the common weld joints.

These ideas and illustrations are not design examples; they are used only as thought starters.

Get the problem posed by your project firmly in mind, review every aspect of it, then think and work out a simple, practical, economical solution.

(For a reprint of this article, circle number 249 on the Welding Info-Aid Card, page 91.)



◄ FIG. 14

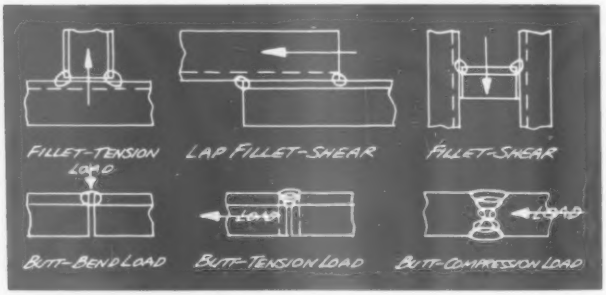
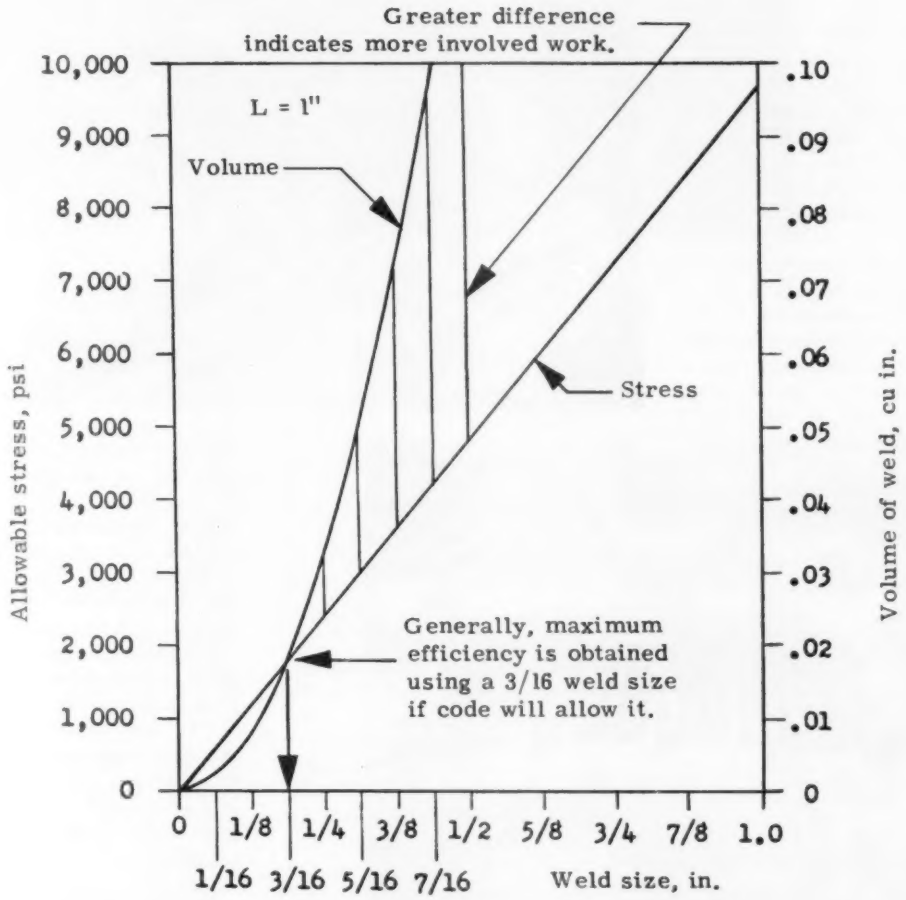
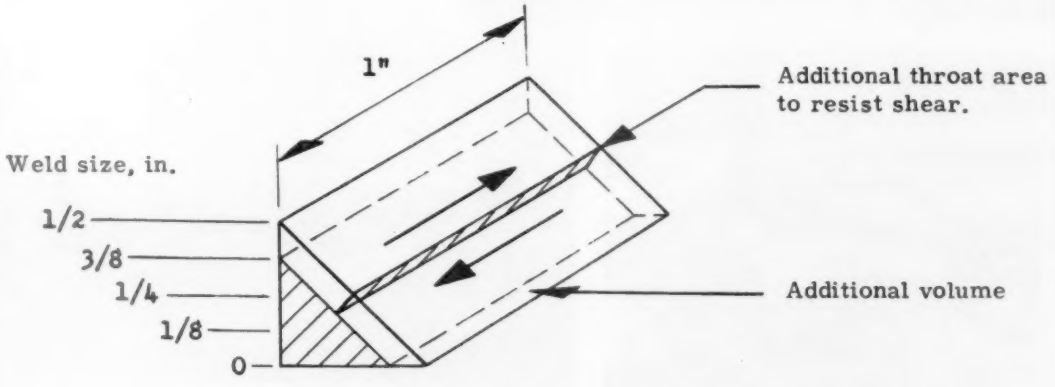


FIG. 15 ►

Determining efficient fillet welds

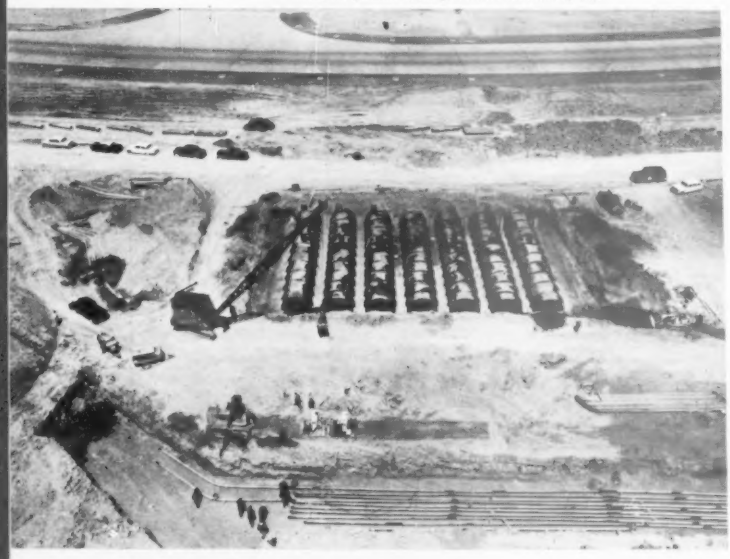




© Earl Kent, 1961

RIGHT: Tank "farm" where aviation gasoline and jet fuel is stored after rail delivery. FAR RIGHT: Submerged-arc welded "satellite" fuel tank with 50,000-gal capacity is one of 39 deployed in 7 underground areas at O'Hare Field to receive fuel from tank farm. BELOW: Ready for backfill is this 7-tank satellite storage area. Note pipes in foreground being laid from tank farm to still another satellite setup.

Aerial photos: Chicago Aerial Industries, Inc.



THAT SOURCE of many a good and bad airport joke — the little red truck — is a forgotten source of hilarity at Chicago's O'Hare International Airport.

Thanks to welding, this claimant to the title of "world's busiest airport" can now fuel its jet and conventional aircraft right at the point of embarkation through underground pipelines.

(At time of publication, WELDING ENGINEER could learn of no other airport in the U. S. equipped with such facilities, though some have reportedly contracted for them.)

The new fueling arrangement at Chicago's 10-square-mile field is comprised of: (1) a "farm" of

LEFT: Weldor completes joint on a portion of the minimal above-ground pipe in one of O'Hare Field's 7 satellite fuel storage areas.

Trucks out, welded pipe in for Chicago plane fueling

all-welded storage tanks where fuel for both propeller-driven and jet craft is stored after rail delivery; (2) 39 "satellite" fuel tanks, holding 50,000 gal each and arranged in seven groups, which feed fuel to (3) "finger" disposal points. The latter are so called because they project like fingers from the main terminal building to points at which aircraft discharge and load passengers.

A total of 202,000 lineal feet of schedule-40 pipe supplied in 40-ft sections, has been manually metal-arc welded to form this complex fueling network. Pipe diameters range from 6 to 12 in., and edges were machine-beveled to form a 60-deg included angle (with a 1/16-in. nose) for welding. Weldors made a stringer bead and two hot passes on all joints. S. J. Reynolds Co., Inc., one of six piping contractors for the civilian portion of the airport (O'Hare also has an Air Force installation), reported that E6010 and E7010 electrodes were used throughout in both shop fabrication and field welding applications. Most common diameters were 5/32 and 3/16 in.

In the shop, power was supplied by 200- and 300-amp electric welders; in the field, by 300-amp gasoline engine-driven units.

Trunk lines were composed of 10- and 12-in. diameter pipe; branches were 6- and 8-in. diameter, and there is pipe of 6-, 8-, 10- and 12-in. diameter in finger areas. All piping is electrically charged to prevent corrosion through electrolysis.

Over 1,700 welds on underground piping were radiographically inspected by Pittsburgh Testing Laboratory, and the Reynolds firm reported minimal rejects.

All weldors were qualified under API standards, and under Procedure 10 of the National Certified Pipe Welding Bureau. The latter covers metal-arc welding of carbon steel pipe, valves, fittings and flanges in the flat, horizontal and horizontal fixed positions.

Architects for the O'Hare project are Naess & Murphy of Chicago.

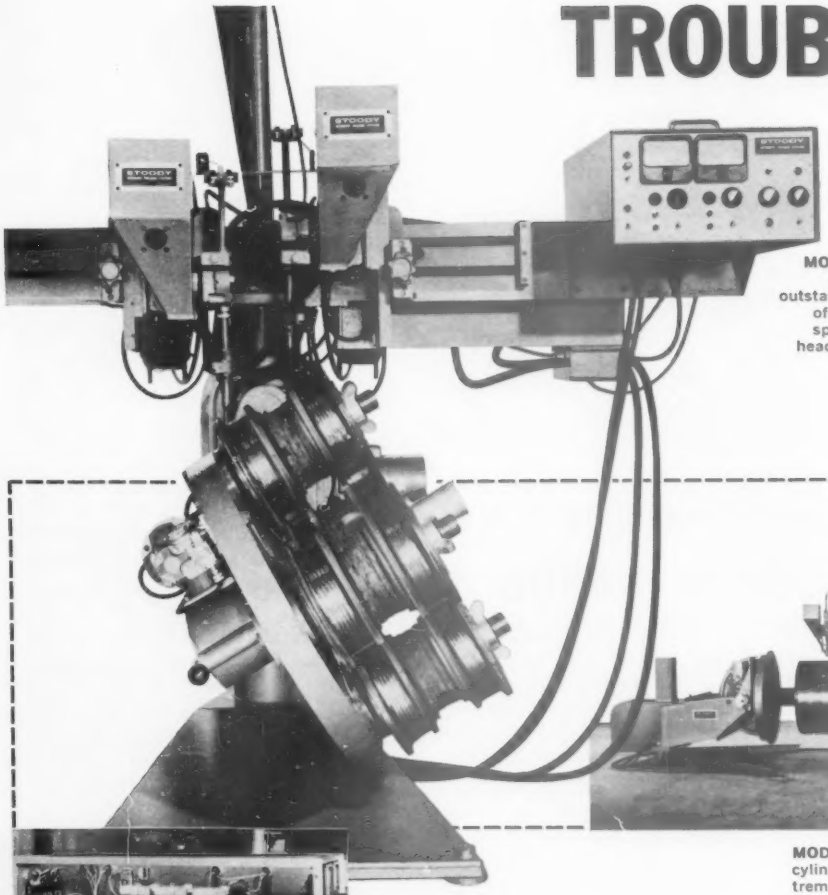
BELOW: Alignment clamps are fitted prior to welding. Piping ranged from 6 to 12 in.

LEFT: Truck-mounted cranes deposit pipe in trench leading from storage tanks to satellite area.

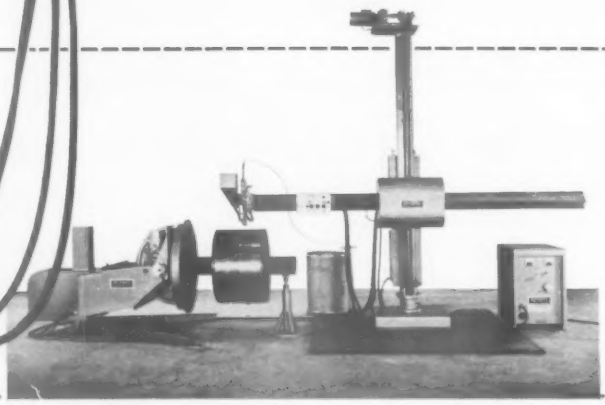
BELOW: Cranes hold pipe over trench as worker collects wooden posts and sandbags on which pipe will be placed for welding.

TROUBLE-FREE

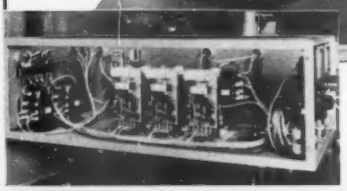
Simplify



MODEL MR—a quality multi-spindle roller-idler rebuilding unit with outstanding operating features. Only Stoody offers a machine with offset main spindle support arm for minimum head adjustment from tread to flange.



MODEL UW—a universal automatic system for cylindrical, conical or straight line welding. Extremely versatile machine for small or large parts.



ELECTRONIC CONTROL PANELS centralize all automatic functions in a convenient, efficient cabinet. All wiring is color coded and numbered. Components are interchangeable between systems.

THE COLD WIRE FEEDER shown above replaced the weak link in an existing automated overlay operation. This is one example of the advanced components that can be designed and made to modify an inefficient, troublesome operation into a smooth-working, high production system.

STOODY AUTOMATIC WELDING SYSTEMS consist of a series of automatic machines and advanced electronic controls designed for heavy-duty rebuilding and hard-surfacing functions. The machines incorporate latest design features, are abundantly powered to provide uniform feed rates regardless of wire size and load, and are equipped with variable feed rates for any required welding speed. They handle everything from tractor rolls, track links and idlers to heavy shafts, trunnions, large rolls, roll and gyratory crushers, etc.

STOODY AUTOMATIC WIRES—A complete range of alloys in continuous tubular wires, meeting all rebuilding and hard-surfacing requirements. Designed to give maximum wear life under specific operating conditions on virtually any equipment.

ECONOMICAL PAYOFFPAKS—Another advancement that increases production when used with Models MR, TL, UW and other STOODY machines. 500 lb. capacity reduces wire cost, permits uninterrupted welding on large parts, avoids storage problems and eliminates lifting of heavy coils on reels. 200 lb. HALFPAKS also available.

TYPE-S SUBMERGING MELT—A superior melt with easy removing characteristics—even at elevated temperatures. This valuable characteristic allows a much wider range of interpass temperatures on applications requiring preheat. Extremely uniform 8 x 48 mesh size.

STOODY COMPANY

11984 E. Slauson Avenue, Whittier, California

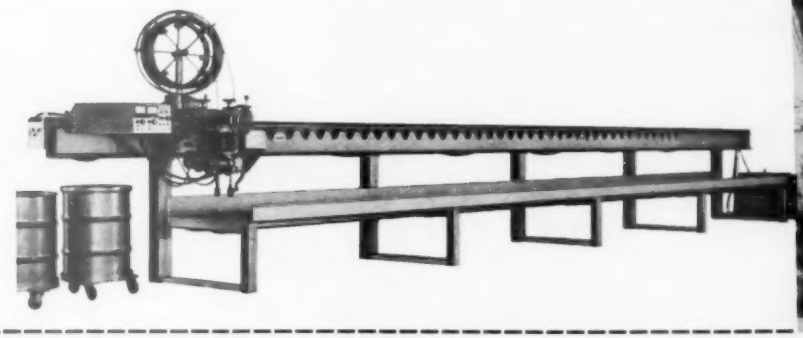
STOODY WELDING SYSTEMS

ALL Automatic Hard-Surfacing Overlay Applications!

Now Stoody, oldest name in hard-facing, offers an additional service to all automatic shops and rebuilders of heavy equipment . . . *a series of automatic welding machines designed for efficient, trouble-free performance!* Each machine performs specific functions on high volume operations. Construction is of highest quality—your assurance of long, uninterrupted service. For the first time, you can obtain both *machines* and *all hard-surfacing overlay requirements* from a single source, developed by a company whose name and reputation for quality has gained world-wide acceptance.

In addition, Stoody *will rework existing machines* to function with greater efficiency and minimum maintenance, and *will design specialized automation* for your specific needs, utilizing standard Stoody Automatic Welding System components.

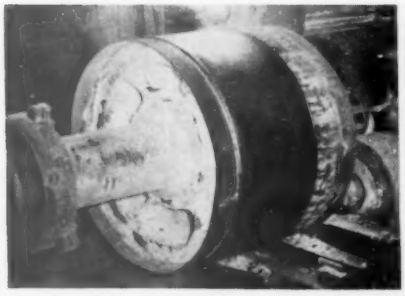
To get more for your hard-facing and rebuilding dollar call STOODY—40 years specialization in hard-surfacing. There's a STOODY FIELD ENGINEER in each dealer's area qualified to help you. To arrange a personal call simply phone your nearest dealer.



MODEL TL—the only dual-headed track link rebuilder that guarantees machine-tool quality construction for accurate, sounder weld deposits. Entire operation is electronically controlled from columnized cabinet.

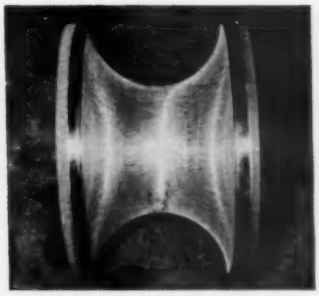
THE CRUSHERMATIC is the result of equipment development to solve a specific overlay problem . . . this unit completely automates the rebuilding and hard-facing of crusher rolls.

TYPICAL APPLICATIONS

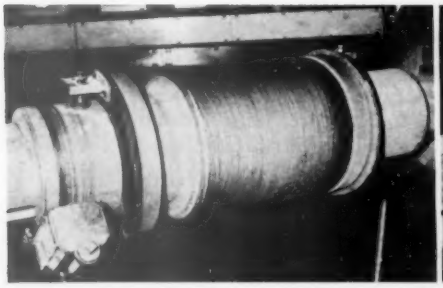


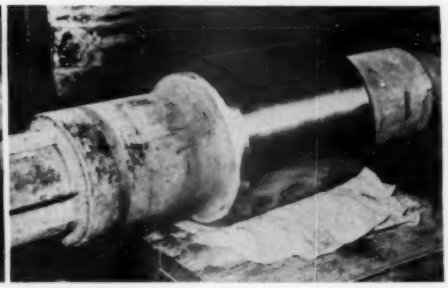
Trunnions are natural applications for Model UW which has a ram-type manipulator with a vertical travel from 6" to 8'-6" and a horizontal travel of 10'.

Inside diameters of many parts are hard surfaced regularly with automatic equipment. The catalyst lift pipe shown was overlaid with Stoody 100 HC.



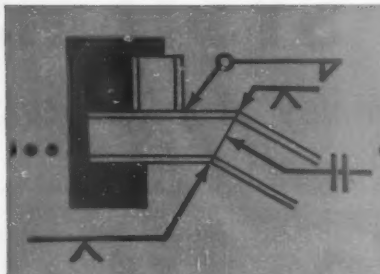
Pipe forming roll overlay and size alteration with Stoody 102 has proved profitable to pipe fabricators.





Flawless surface on banding strip finishing rolls—shown as welded and rough machined—was made automatically with high-hardness (60 Rockwell C) Stoody alloy.

For more facts Circle No. 181 on Welding Info-Aid Card



the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

How to weld white metal

WHITE METAL IS OFTEN used for components in household appliances.

When these appliances break or crack, many weldors cannot, or will not, repair them. These weldors claim either lack of experience or point to the problems resulting from the low melting temperatures of the zinc alloys.

According to THE WELDING ENCYCLOPEDIA, 14th edition, however, these metals can be welded.

First, white metal, gravity or pressure castings fall into three general classes — zinc, aluminum or magnesium.

If the type of alloy is not known, identify it before you attempt to weld. This can be done, roughly, by weight: magnesium alloy is very light; zinc alloy is very heavy; aluminum falls between the two

The most commonly used aluminum and magnesium alloys melt at 1,080 to 1,195 F while zinc alloys melt at 725 F

Zinc alloy die castings are made in much higher tonnage than aluminum or magnesium and so are more likely to be encountered Most are made of the following approximate composition:

Aluminum - - - - - - - - 4.10%
Copper - - - - - 1% to 2.70%
Magnesium - - - - - 0.03% to 0.04%
Zinc- - - - - - - balance

For these zinc castings, the weldor's neutral torch flame should be 5,800 F. When adjusted with the required excess of acetylene, the temperature should be somewhat lower.

Since this oxyacetylene flame is much hotter than necessary, it is important to select a tip no larger than a 72 drill size.

Adjust the flame with an excess of acetylene so it approaches a yellow color, but not so much that it coats the metal with a carbon deposit.

Before welding, vee out the crack as usual. If the crack is broken clear through, grind or file edges to an angle of about 45 deg and line the parts up on a carbon block.

If the casting is chromium or nickel plated, grind away plating where the weld will be. Support the casting under the weld so metal cannot flow away or sag. Use a brass rod flattened at one end as a spatula and, if available, use wet ground asbestos or weldor's clay for support.

Heat the casting gradually until the metal starts to flow. Turn the flame parallel to the surface, and with the side of the flame, hold the metal at this heat.

With both base metal and welding rod at this temperature, touch the rod to the break and let it flow into the vee for thorough fusing.

Repeat this operation until the break is completely filled. Be sure to apply some pressure on the rod to break down skin resistance or the filler rod will lie on the surface and not fuse.

Puddling is necessary only when you have piled the rod on top instead of fusing it to the base metal. Then, heat the base metal and rod to flowing temperature and work rod into base metal with a bronze rod using it as a paddle. It takes careful manipulation and patience, but it can be done.

Magnesium die castings are about ⅔ the weight of aluminum and less than ¼ the weight of iron or steel. Such ultra-lightweight castings contain about 90 to 98% magnesium.

These castings can be oxyacetylene welded using a rod and special flux. All the flux, however, must be removed to prevent corrosion and welding must be done carefully.

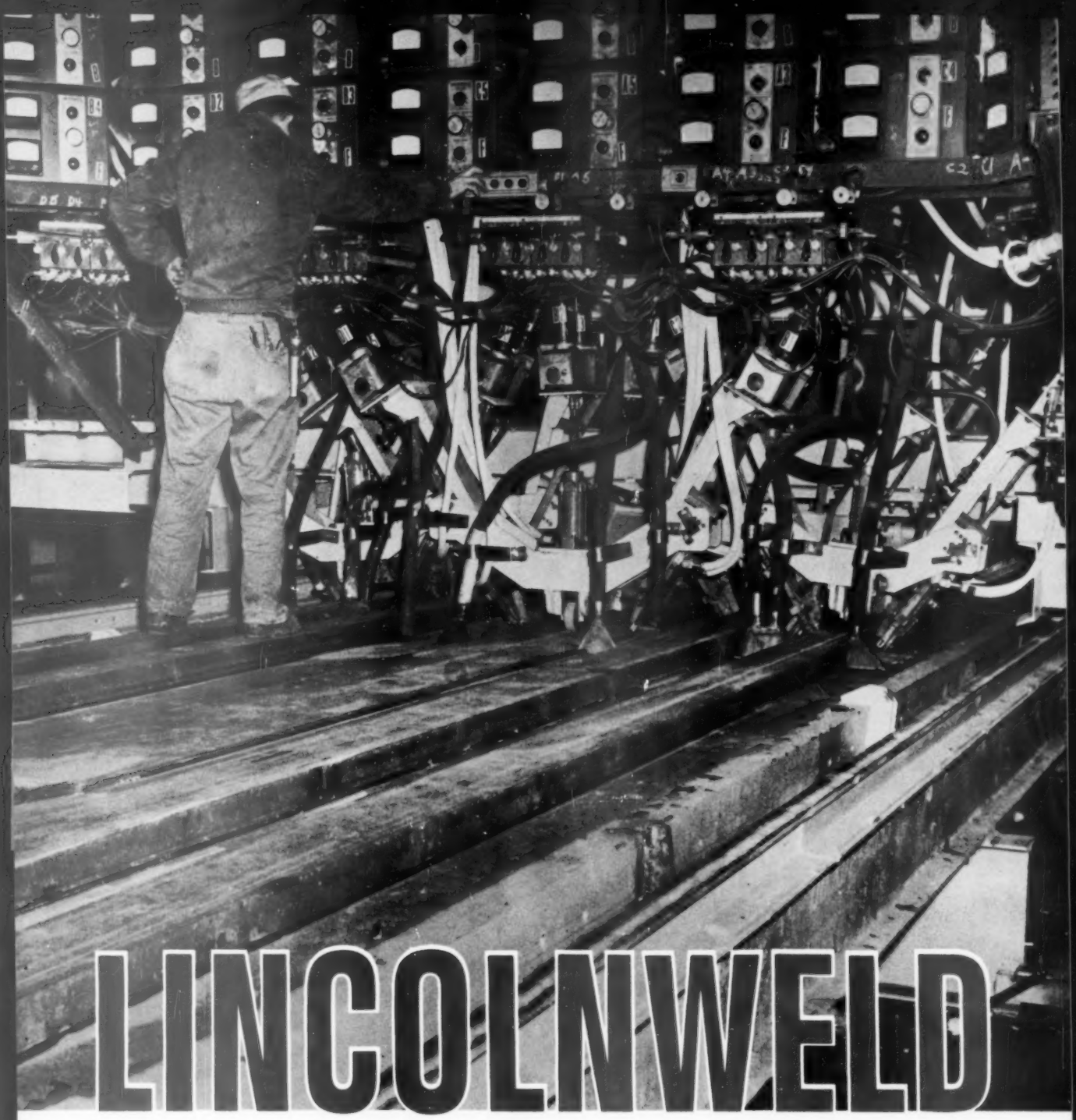
After welding, thoroughly clean the part with hot water, treat with a chrome-pickle solution, and then paint it.

Soldering can be used to plug small sand holes and other surface defects as occur in magnesium die sand castings. However, soldering is not recommended if the soldered area must withstand stresses.

Solder can also be used to build up the surface of magnesium alloy patterns with no flux needed.

Remember, some of the alloys you encounter will be unweldable. It is usually possible to determine the weldability of the metal by trying to weld on a small part of the break to see if the metal can be fused.

For more facts Circle No. 182 on Welding Info-Aid Card →



LINCOLNWELD

Here's an expensive, fully automatic submerged arc setup with 16 welding heads. Press the button. Can you count on them all to start perfectly? Every time? This manufacturer can. He chose **Lincolnweld** equipment. Because he knows its welding dependability, ruggedness and easy serviceability will protect his investment and guarantee production by consistently delivering good welds . . . fast . . . at low cost. What is it about **Lincolnweld** equipment that makes these things possible? Why not spend the next few moments reading the answer inside?

These are LINCOLNWELD automatic submerged arc welders on the job

Tractor-mounted LAF-3 head welds the giant hull sections of this atomic submarine. After sections are butted together, entire hull is rotated under the unit to complete the 360° weld. New **Lincolnweld** tractor permits use of tandem-mounted heads to get higher speeds, greater efficiency from tractor setup.

LAF-3 head, used for DC welding, lays large fillet on this bridge section at speeds not possible by any other process. Note conveniently mounted controls which let operator govern the process at all times. No involved electronic circuitry to get out of order. Your own shop electricians can keep **Lincolnweld** controls in top operating condition.

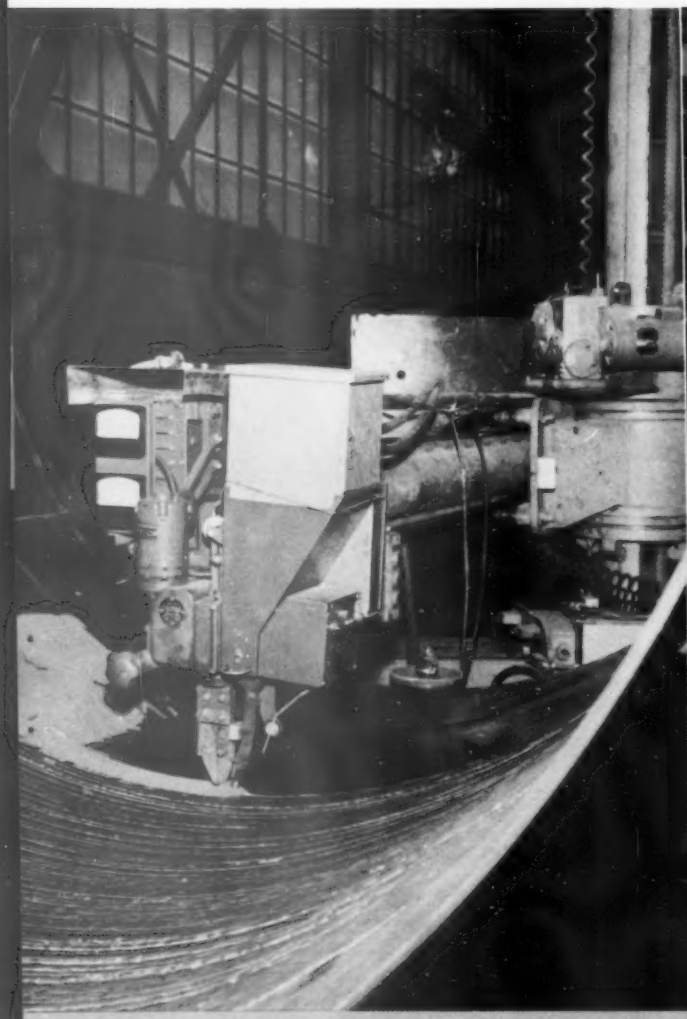
Whether you weld automatically with AC or DC, in the factory or in the field, whether your setup calls for stationary head mounting or travel carriage or tractor, single or double-wire feeds, Lincoln makes equipment to do the job. It's called **Lincolnweld.**

The LAF-3 is for DC, LAF-4 for AC, and LAF-5 for DC welding where there's no 3-phase power source. To get higher speeds or deeper penetration, or to bridge large gaps, any one of these welders can be fitted with two-wire, **Twinarc** heads. Or, they can be mounted in tandem to get very high speeds . . . up to 200 ipm.

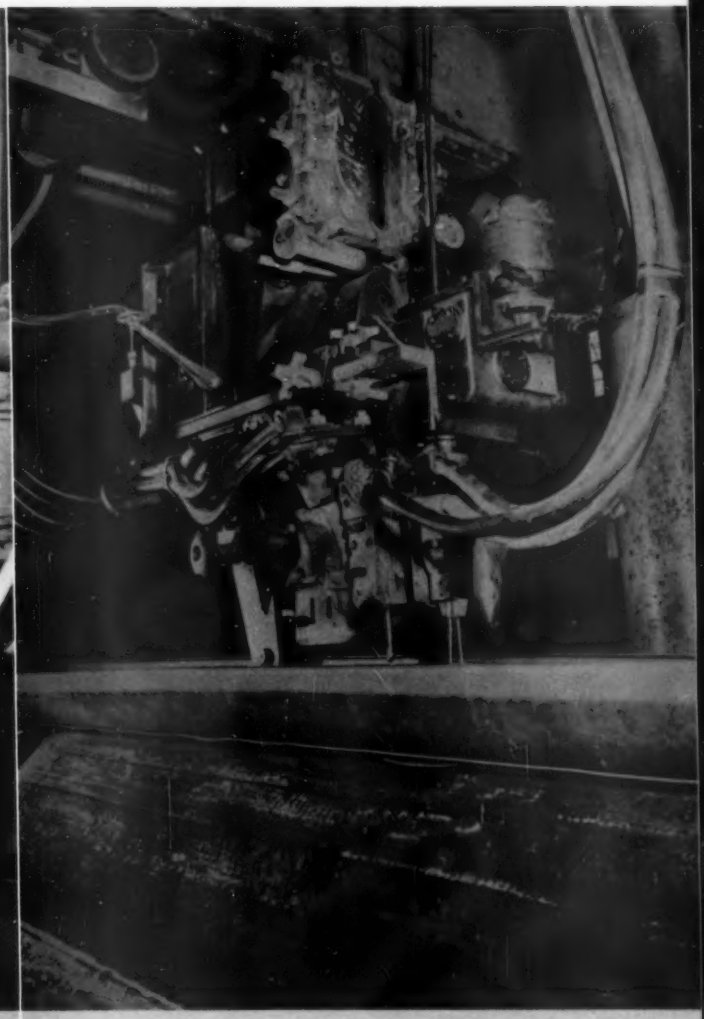
LINCOLN WELDERS

What's more, this equipment is rugged, practical, simple. It ties into existing fixtures easily and its controls integrate easily with the over-all control system. Meters, buttons, controls are all conveniently mounted for work and service. Components are conventional in design. No temperamental electronic equipment to get out of order. Your own electricians can keep this equipment delivering topnotch performance.

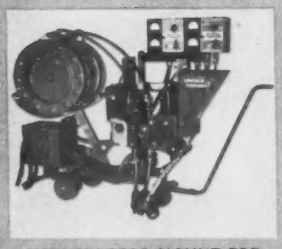
Day-in, day-out welding is rugged. To produce finished parts quickly and at the lowest possible cost, and to protect your investment, use equipment equal to the task . . . **Lincolnweld.** See your Lincoln field engineer . . . a specialist in welding . . . to get all the facts about **Lincolnweld** submerged arc equipment. Ask him for bulletin 5200.1. Or write, The Lincoln Electric Company, Cleveland 17, Ohio.



By hardsurfacing the inside shell of this dust collector, its life was increased six-and-one-half times. Neither high-frequency current nor steel wool balls are needed to start Lincolnweld arc. Just push the button. You get perfect starting every time! And flux flow starts automatically, too, when the arc button is pushed.



Tandem-arc arrangement—two or three heads mounted in tandem—lets you lay down up to three times as much metal as with a single-wire setup. Here, a single ⅜-inch electrode operating on AC is fed in tandem with a DC **Twinarc** head which simultaneously feeds 2, ⅛-inch electrodes into the work. Setup completes root and cover-pass welds in single pass on heavy locomotive motor frames.



NEW TRACTOR MOUNT FOR
LINCOLNWELD EQUIPMENT

BOOM-MOUNTED
LINCOLNWELD HEAD

LINCOLNWELD
LAF-3 HEAD
ON CARRIAGE MOUNT

You can count on LINCOLNWELD heads for perfect starts and uniform welds

Lincolnweld equipment is built to deliver reliable performance. It is the only submerged arc equipment which gives consistently perfect starts (without skipping) on low or high-speed welds. The uniformity of its welds hour after hour, day after day, have earned it a reputation envied by all.

Right now there are thousands of **Lincolnweld** units in service laying down metal efficiently, effortlessly. Their users are saving money with every minute of that production time. Perhaps you could benefit by investigating the many ways **Lincolnweld** could be profitably put to work for you.

THE LINCOLN ELECTRIC COMPANY
Dept. WW-2112 Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment and Electrodes

LINCOLN ...U.S.A.

INNER and outer sheets forming the large bulkhead at one end of the space capsule are resistance seam welded. Intricate pattern of welds creates small, sealed pockets designed to stop any crack immediately. Note offset rows of stamped stiffeners.

U. S. space capsule — how it was welded

SPECTACULAR, albeit suborbital, as the flights of U. S. Astronauts Shepard and Grissom may be, some unspectacular and earth-bound manufacturing processes made these space probes possible.

Prominent on the list of processes used to fabricate the Project Mercury capsule are Tig and resistance seam welding.

The capsule, one of 20 built by McDonnel Aircraft Corp., St. Louis, consists of an outer shell of Rene 41, and an inner shell of AMS 4901 titanium.

Making up the inner shell are three components: the cone-shaped side wall, a large spherical bulkhead at one end, and a small bulkhead on the other end.

Two layers of the 0.010-in.-thick titanium are used to form the side wall and the larger bulkhead. The inner sheet is smooth while the outer one is stamped with offset rows of reinforcing stiffeners (*see photo*).

Size limitations on available titanium sheet require that each of the layers in the bulkhead and the side wall be made from several sheets welded together: three of them for the bulkhead and eight for the cone's side wall.

To obtain the reinforcing stiffeners, the titanium sheets are hot-formed, *i.e.*, resistance heated to 1,000 F, then formed with a drop-hammer and die setup.

After forming, the side wall panels are rough trimmed and placed on a cone-shaped mandrel matching the part. To prevent any possible cracking in the stiffener areas because of forming, the panels are then stress relieved for one-half hour at 1,000 F. Pickling and dye penetrant inspection follow.

(To form the spherical panels for the large bulkhead, similar operations are used, allowing for the difference in shape.)

The panels are then trimmed to size and the edges milled (not sheared) to provide a straight, burr-free edge. Finally, an alcohol agent is used to clean the edges of all grease and other contaminants.

The eight sheets of the inner, smooth side wall are the first to be automatically Tig welded using an 0.040-in.-diameter tungsten electrode. Power source is a 200 amp d-c welder with a current setting of 22 amp at 8 volts.

With a maximum gap of 0.004 in., all welds were completed in one pass at a rate of 7 ipm. Argon shielding was used for both the weld zone (15 cu ft per hour) and the backup plate (4 cu ft per hour).

To hold the proper shape during welding, the panels are strapped to a cone-shaped supporting fixture, and as additional panels are welded, each one is placed on the same relative area on the fixture.

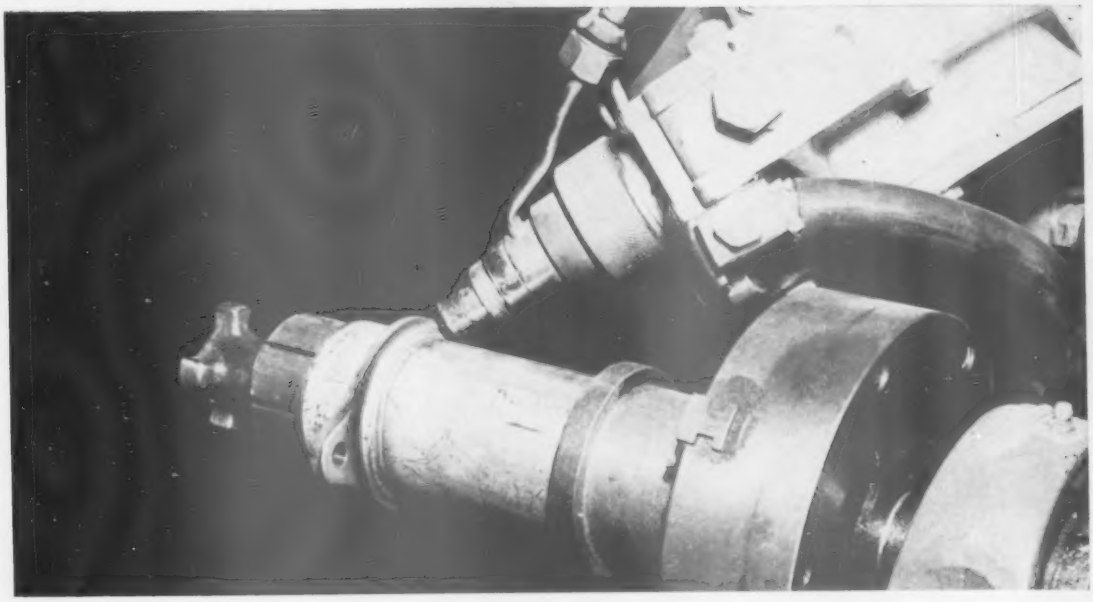
The spherical sheets for the large bulkhead are welded in the same manner, except that a center sheet and two side sheets are joined to form a 6 ft long curve.

In this operation, the Tig torch is stationary while the part to be welded is rotated by a fixture. Welding speed is still 7 ipm, however.

When Tig welding is completed, the inner and outer layers of the side wall and bulkhead are resistance seam welded.

The intricate pattern of the approximately 22,000 in. of longitudinal and circumferential seam welds create small, sealed pockets designed to immediately stop any crack.

Stiffening rings and angles are then either seam or spot welded to the side wall.



Which water cooling system best suits your particular needs?

by **R. A. Bernard**
President
Bernard Welding Equipment Co.

WELDING SPEED in all electric welding processes is proportional to the kilowatt energy used, and modern welding procedures are continually demanding equipment that will handle higher and higher welding current levels.

Since in most cases equipment size and weight are already at a maximum, the only means for conducting these higher current levels without further size or weight increases is to water cool the equipment.

The primary consideration when using water-cooled equipment is selection of a cold water source. There are three possibilities:

1) **City water** — This includes municipally supplied water, water from wells, etc., where the water is used for cooling only once. Such a water source should be used, if:

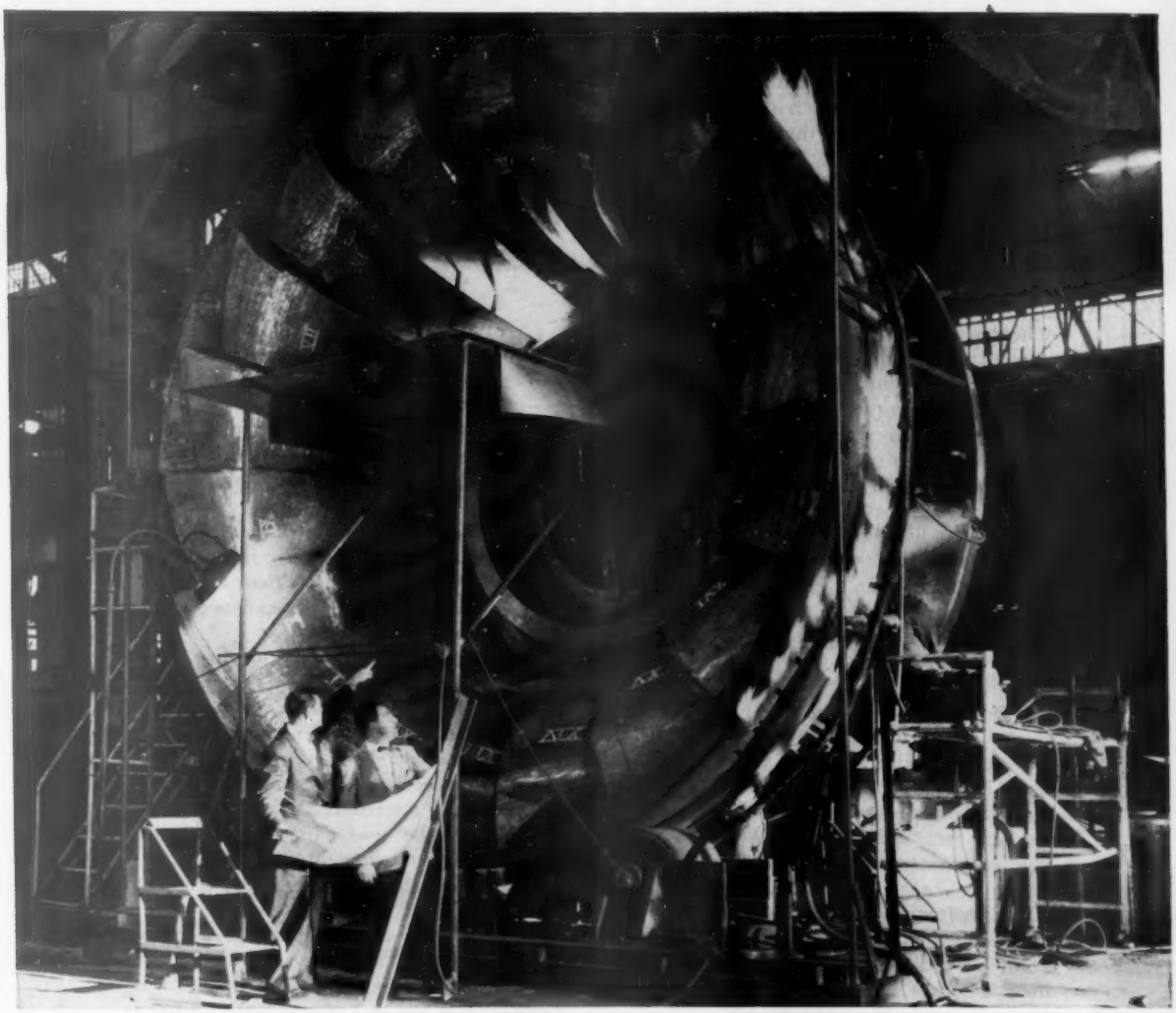
(a) **The water is not expensive, i.e., the cost of water per welding unit is less than $50 per year.**
(b) **The water is clean and not more than five grains per million in hardness.**
(c) **Water and drain lines are within 30 ft of the welding apparatus, or if the cost of installing water lines and drains will not exceed $50 per welding unit.**
(d) **The welding equipment installation is considered permanent, meaning portability is not required and no departmental changes are anticipated.**
(e) **Adequate water is available and no water conservation program is in effect.**
(f) **Freezing temperatures are not anticipated in the welding area.**

2) **Central cooling system** — This may consist of either a large tank of water (4,000 to 40,000 gal) with a large volume pump (with or without air-to-water heat exchangers), or a smaller tank (2,000 to 10,000 gal) using a refrigeration unit with ample capacity for removing heat.

Such a system eliminates the water cost factor of the city water supply; allows the use of filtered and softened water; and should be considered when 25 or more welding units are to be used in a limited fabrication area. However:

(a) **This is the most costly of all systems to install.**
(b) **Cooling equipment failure generally results in a complete standstill in the entire production area.**
(c) **It is quite inflexible and hence, is usually limited to long run production areas.**
(d) **Most of this equipment must be custom built for the requirements needed.**

3) **Individual "self-contained" coolant systems** — This is always the preferred method of cooling



For X-ray quality welds in low alloy high tensile steels . . .

specify ATOM • ARC® electrodes

Since the introduction of Atom • Arc all position iron powder low hydrogen electrodes in 1954, they have become famous for one outstanding quality . . . X-ray sound welds. Other Atom • Arc qualities, of course, have been profitable and advantageous to the user. However, no one quality has saved as much time and money for the discerning fabricator or steel erection contractor as the X-ray soundness of the weld metal. Chipping and rewelding defective areas has been reduced to a minor factor where Atom • Arc electrodes are used.

For X-ray quality welds, higher deposition rates and superior arc characteristics, we suggest that you specify Atom • Arc iron powder low hydrogen electrodes. They are available in strength levels and chemistry for the welding of nearly every type of low alloy high tensile steel. To find out how these outstanding electrodes fit into your welding needs, send for "Handbook for Welding Low Alloy High Tensile Steels." Write to Alloy Rods Company, P. O. Box 1828, York, Pa.

ALLOY RODS COMPANY

YORK, PENNSYLVANIA

SALES OFFICES AND WAREHOUSES • BOSTON • NEWARK • PHILADELPHIA • PITTSBURGH • BIRMINGHAM
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For more facts Circle No. 183 on Welding Info-Aid Card

when five or less welding units are located in one area, when more than five units are spread throughout a very large area, or when the cost factors of the other two sources exceed those of these self-contained systems.

These coolers consist of a large variety of small, inexpensive coolant sources generally designed for cooling one piece of welding apparatus, or in some cases, as many as five can be handled with the one cooler. There are two basic designs:

The heat reservoir or tank type consists of a tank of water on top of which is mounted a motor and pump for circulating the water. The main difference among the various units is the tank itself.

It may consist of merely a 55 gal steel drum, or an elaborate portable unit consisting of a flat tank mounted on wheels and upon which the welding apparatus is placed for mobile use.

The heat handling capacity of these units is based on the amount of water the tanks will hold and on the radiation area of the tank. Common units range from 10 to 40 gal; larger units are generally impractical because of the excessive water weight.

The second type of self-contained water coolers consists of a relatively small coolant reservoir (1 to 5 gal) with the addition of an air-to-water heat exchanger. For compactness, the most efficient systems use a two or three stage radiating system.

These heat-exchanger units are superior to the tank type units since they have considerably more heat removing capacity; are much smaller and lighter; and in freezing temperatures, their smaller liquid requirements permit economical use of anti-freeze solutions, either full strength or diluted. However, they are more expensive.

Desirable features in these coolers are:

(a) **Positive displacement pumps (gear type and not impeller type), since welding equipment designed for water cooling will be destroyed without adequate cooling, i.e., a positive coolant flow is essential.**

(b) **A visable means should be provided for checking water flow.**

(c) **Water tanks should be of non-corrosive construction, lined with either lead, neoprene or some other suitable lining material.**

(d) **Adequate filters (180 mesh) should be provided to keep foreign particles out of the welding apparatus.**

(e) **Tanks should be completely sealed and covered to prevent evaporation and introduction of shop dirt, and be vented above liquid level to permit expansion and contraction of the liquid without loss.**

Advantages of these self-contained coolers are:

(a) **Ease of installation, normally in less than one hour.**

(b) **Normally the lowest cost per welding unit.**

(c) **Eliminates plumbing installations and long lengths of hose on floor areas.**

(d) **Eliminates the dependence on city water supplies.**

(e) **Provides portability for the welding equipment.**

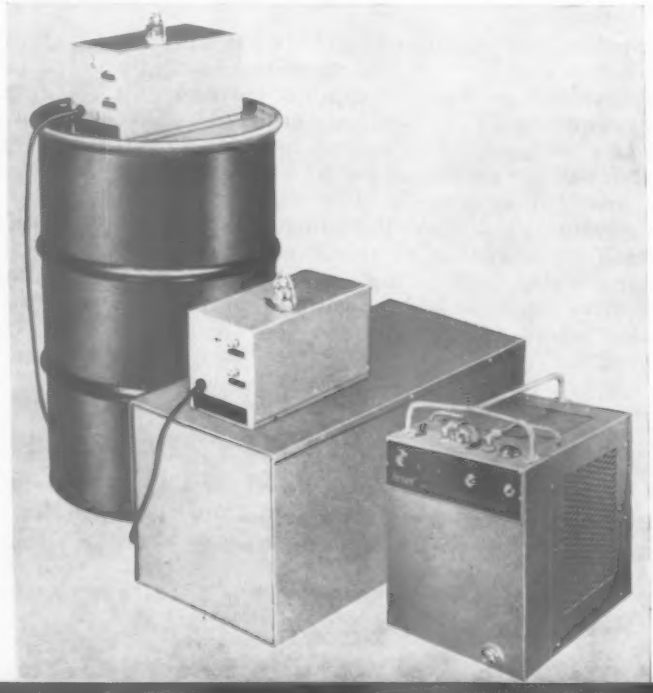
(f) **Highest reliability.**

No matter which water source you use, the prime requirement is reliability. A constant and adequate supply of cooling liquid must be delivered without even minor interruptions.

Most of the newest high speed welding methods involve high equipment investment costs, and an interruption of cool water (even if momentary) can be disastrous.

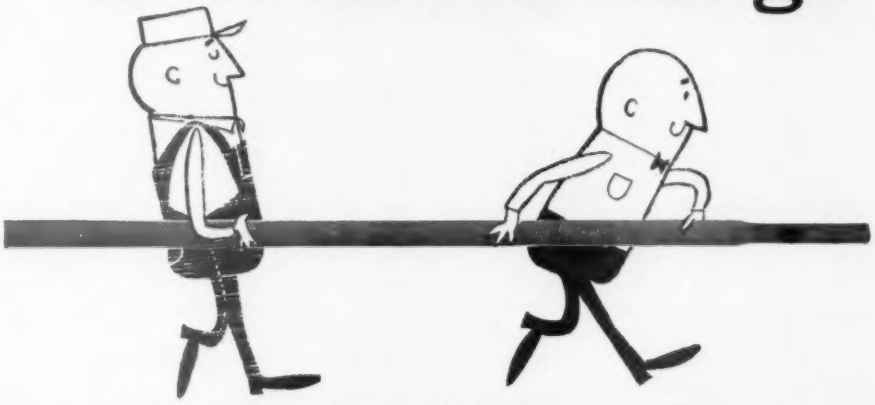
Currently, many companies which supply such welding equipment are providing interlocks to prevent operation when the coolant flow is not adequate.

After the reliability of the water source has been established, make sure that it is the proper cooling

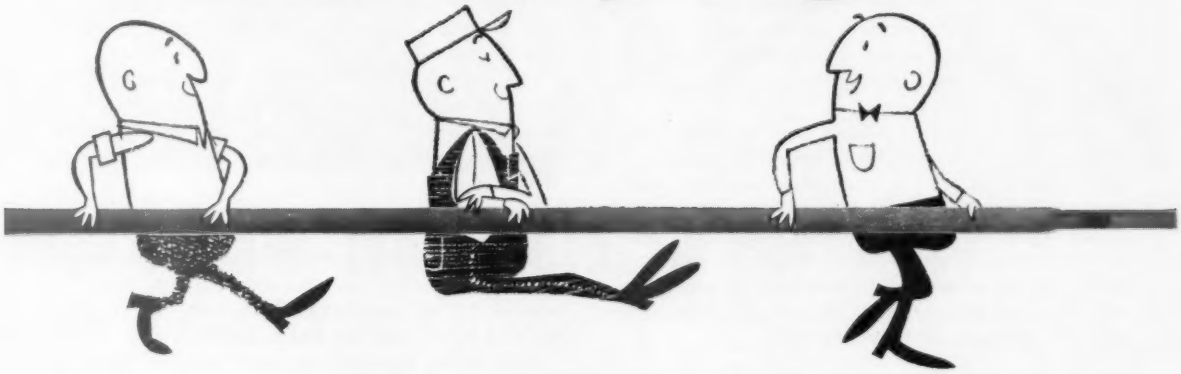


INDIVIDUAL "self-contained" coolant systems are always the preferred method of cooling five or less welding units in one area or more than five units spread over a very large area, but especially when the cost of the city water or central cooling systems become excessive.

A. O. Smith will go



to almost any length



to be of service to you!

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system for the particular welding method you are planning to use.

Tig welding

All Tig torches are, for the most part, water cooled with the exception of a few made for handling low welding currents. However, even in the low current ranges water-cooled torches are more popular because of their smaller size and lighter weight, and because of the recent availability of low cost self-contained coolers.

One of the important considerations in water-cooled Tig equipment is that the greatest amount of heat generated is developed in the water-cooled welding current cable assembly and not in the torch.

For example, Tig torch equipment with a 10 ft water-cooled cable, welding at 200 amp, experiences a 5 volt drop in the current cable. This represents a 1,000 watt heating load which must be carried off by the water.

Therefore, it is advisable to pass the cold water through the cable-containing hose. This, of course, allows the torch to operate at advantageously lower temperature levels.

Tig equipment can use any of the three water sources mentioned, provided clean, soft water is used. The recommended method is to use individual self-contained coolant units. Simple tank type units are very popular for these torches.

A rough rule of thumb regarding tank size is to allow 10 gal of water for each 75 amp of anticipated welding current at a 60% duty cycle.

For example, if the maximum welding current expected is 300 amp, at not more than a 60% duty cycle, then a cooler with a 40 gal tank would most likely be used. If two to five torches are to be used in the same welding area, one heat-exchanger type of self-contained cooler could be used for cooling all torches, and at a substantial equipment cost savings.

In most cases, it is advisable to set the pressure relief valve on the coolers at about 25 psi or less to minimize the possibility of leaks in both torch and hose fittings. Of course, it should be remembered that the only way to increase the volume of liquid through a given piece of equipment is to raise the pressure, and with certain makes of torches this is necessary because of unusually small, constricted passageways.

Often Tig equipment uses a superimposed high frequency current for ease in starting the arc or for maintaining a pilot-arc. These high frequencies often cause the water to become conductive and, thus, lose their effectiveness.

The only solution, in such cases, is to use distilled water without a soluable lubricant or any form of non-corrosive additive, and to exercise care in preventing any foreign material from entering the cooling system.

Mig welding

Basically, Mig equipment is cooled in the same manner as the Tig equipment. Probably from a cooling standpoint, the biggest difference is in the higher current levels used by the semiautomatic equipment.

Although some of the newer dip-transfer or short-arc equipment operates in lower current ranges, it is always advisable when a tank type cooler is used that it be not less than 40 gal capacity. And in such cases where welding procedure uses 400 amp or more, a cooler of the heat-exchanger type is generally a necessity. Where portability is required, one of the portable type coolers is recommended.

Mig or Tig cutting

These processes of non-ferrous cutting are characterized by their need for large volumes of water at high pressures (60 to 90 psi). Tank type coolers are generally not recommended because of inadequate capacity.

A heat-exchanger type with a flow rate of 1½ to 2 gal per minute at 90 psi, and with a caloric rating of 200 BTU per minute or higher, is generally recommended. Distilled water is normally a necessity.

Automatic arc welding

Most automatic arc welding processes make use of a water cooled torch to retard the collection of spatter on the nozzles, but generally, the welding current cables are not water cooled.

The higher current ranges and duty cycles maintained with automatic equipment generally offsets the reduction in the heating load of a water-cooled current cable, and thus, the same rule of thumb should be applied for selection of the self-contained cooler as with Mig or Tig manual welding.

Aircraft, missile and other critical automatic welding equipment should always be cooled with the self-contained heat-exchanger coolers. These assure not only constant pressure and flow rates but also maintain definite operating temperature levels.

These features contribute to the desired effect of maintaining constant welding conditions to con-

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trol exact depths of weld penetration on thin gage metals as well as the heavier gages.

Many fixtures used in automatic arc welding call for the use of water cooling, either to protect the fixtures and/or to minimize heat effects in the parts to be welded. Since the water cooling requirements vary over a wide range for each particular application, no specific recommendation can be made for the water source to be used.

Most often, due to high heat levels required, city water is the only solution. However, on lower heat levels, self-contained coolers should be utilized when possible to maintain uniform cooling for exact welding conditions and to eliminate condensation problems (self-contained coolers never operate below room temperature).

Resistance welding

This welding process has long recognized the merits of water cooling, and the great majority of resistance equipment now in use utilizes water cooling. Originally, only electrodes were water cooled, but now there are water-cooled thyrotron firing tubes, transformers, rectifiers, etc.

Because of the extremely high heating characteristics of the processes, most of the water used comes from either city water mains or large central cooling equipment. Only on equipment of 30 KVA or less is the use of individual self-contained coolers practiced. In these smaller machines use of self-contained coolers should definitely be considered since quite often substantial savings in both installation costs and water costs can be realized.

Miscellaneous processes

Both plasma metallizing and welding, and induction welding equipment make heavy demands on water cooling and cannot operate commercially without it.

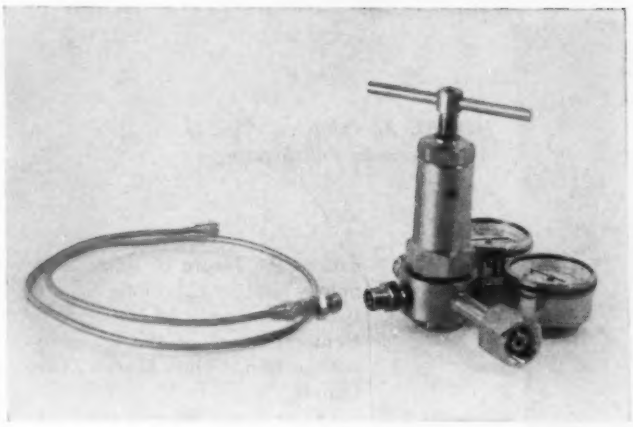
In plasma welding the present cooling method is to use distilled water and recirculate it through the equipment and through a water-to-water heat-exchanger connected to a city water supply. New methods of cooling plasma equipment are now being developed and indications are that substantial savings in both equipment, installation and operation costs will be effected.

The status of water cooling for induction welding equipment is much the same as for plasma.

Water cooling has been practiced on larger welding units, where its use was a necessity, for many years. But recently its use in smaller apparatus has increased, especially in hand held tools where it affords the design opportunity of lightness and small size.

Now with the advent of small, inexpensive, self-contained coolers, water cooling can be used to its fullest advantage with the elimination of many of the earlier problems connected with use of city water.

(*For a reprint of this article, circle number* 250 *on the Welding Info-Aid Card, page* 91).



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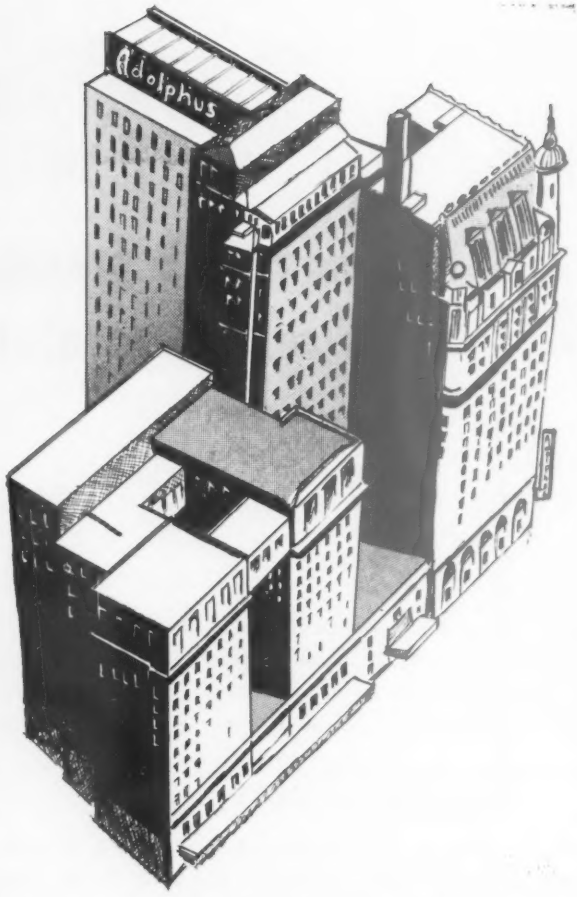


HOTEL Adolphus . . . site of AWS National Fall Meeting

Deep in the heart of . . .

Dallas to host AWS fall meeting; 17 sessions planned

MORE THAN 46 papers will be presented at the 17 technical sessions scheduled for this year's National Fall Meeting of the American Welding Society.

Co-sponsors of the meeting, to be held Sept. 25-28 at the Hotel Adolphus, Dallas, Texas, are the Atomic Energy Commission Welding Forum, the Society for Nondestructive Testing, and the Welding Research Council. Each organization will sponsor one session.

Topics of the papers to be presented will range from ultra high-strength steels, nuclear components, and aircraft and missiles, to the newest developments in the welding processes and techniques, such as electron beam, plasma arc and friction welding.

At last year's fall meeting the session on basic research was so successful that it has been included again this year and expanded to a day-long symposium on Wednesday, Sept. 27. The two papers to be presented at the opening session of the symposium will deal with residual stresses, and the effect of plate thickness and radiation on heat flow.

After the official opening of the convention by AWS President A. F. Chouinard on Monday morning, the keynote address will be given. Speaking on the problems of missile design and fabrication, the future of space technology and our position in the space race will be Robert B. Demoret, chief of the astronautics section, The Martin Co., Denver.

(For a report on how the U. S. space capsule was welded, see page 59 this issue.)

Several workshop meetings are also scheduled and will cover such subjects as welding in the oil industry, hose for oxygen cutting processes, and the influence of gas pressure on regulator design.

At the educational open meeting and the open meeting for section publicity chairmen, section officers will learn the mechanics of communication and how to present educational courses. University and industry speakers will preside.

Activities other than the regular sessions are also being planned. Two plant tours will be conducted, one to Convair's Fort Worth plant, and a second to the Gardner-Denver plant, Mayhew division, where the world's largest and smallest oil well drilling equipment can be seen.

The traditional convention dinner has been expanded into a western barbecue to be held Tuesday evening at the Austin Patio Ranch. A posse will meet the guests at the gate and escort them to the ranch house. A rodeo in the ranch arena will highlight the entertainment.

Nor will the ladies be neglected. Their scheduled program includes a bridge luncheon, tours of the Fort Worth Museum of Western Art (Tuesday) and the Wholesale Decorative Center (Wednesday morning), plus a fashion show by Dallas' world-famous department store, Neiman-Marcus (Wednesday afternoon).

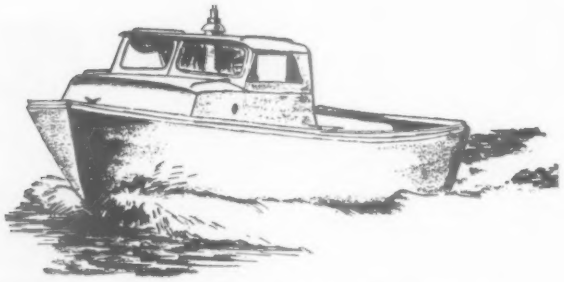
The only things old about WELDING ENGINEER/1961 are its name and its editorial experience

THE NEW LOOK/'61 - Smarter looking covers, with many in full color, and a fresh design for our name. Inside, more and bigger illustrations and photos; better visual presentation of articles, along with the complete and concise editing that is traditionally WELDING ENGINEER. Easier reading too, because of the new typefaces used in articles and captions. **CONVENIENCE/'61** - New location makes New Product section easier to find; still has more information about more new products than any other welding publication. You keep abreast of Capitol news and undercurrents with monthly "Dateline: Washington". INFO--AID card swings out so you can request additional information about ads, new products or literature as you read. Stays with each issue until you're ready to mail it (easy to use and hard to lose.)

These are just the latest in developments at WELDING ENGINEER. As usual, WE will give you the best coverage of the changing world of welding-and the regular wide range of monthly features. And, as usual, WELDING ENGINEER will continue to make changes that will make your magazine more helpful to you.

From small fishing craft to huge ferryboats . . .

Mig + 5086 aluminum = lightweight boats



ALUMINUM gillnetter weighs 6,000 lb and can double speed of conventional wooden vessels like it.

MIG WELDING AND 5086 aluminum alloy have teamed up to produce the latest entries in the growing marine market — a 116-passenger ferryboat and 32 compact fishing craft.

To fabricate the all-welded ferryboat — one of the largest all-aluminum watercraft yet made — Chaffee Machine Co., San Diego, used automatic argon gas-shielded Mig welding and aluminum alloy filler wire made by All-State Welding Alloys Co., Inc.

The Catalina Island ferryboat, using some 30,000 lb of Kaiser 5086 aluminum alloy, was completed about three months faster than a comparable wooden or steel craft, according to the firm.

Engine girder and frame fabrication was done on a table prior to installation on the vessel. The main hull section was fabricated upside-down to ease shell plate welding in the flat position. This also permitted all vertical and horizontal welding in the hull before the shell plate was applied.

Using carbide-tipped woodworking tools, the boatmakers claimed they could saw and shape the aluminum plate with less trouble than it takes to handle plywood.

To fabricate the 32 all-welded gillnetter fishing boats used in Alaska's fishing grounds, mass production techniques were used to provide lower per unit costs compared to wooden vessels.

In addition, each of the fishing boats weighs only 6,000 lb compared to 10,000 lb for wooden ships of similar size. Kaiser 5086 aluminum alloy was again used.

Using Mig welding, three weldors can complete a gillnetter hull in five 8-hr shifts. Working in two shifts, Matsumoto Shipyards, Ltd., North Vancouver, B.C., launched the boats at a rate of two or three per week.

Hull plates for these fishing vessels are ¼-in. thick. Bulkheads, floor plates and deck are 3/16-in. plate and cabin structure is ⅛-in. plate.

In production, sheet aluminum is cut to shape by power saws before being welded around a steel jig shaped like the hull which is bolted upside-down to the shipyard floor.

Following welding operations, the hull is lifted from the jig by an overhead crane, turned upright and moved along the assembly line for installation of the engine and other marine fittings. One-piece welded cabins for these boats are also fabricated around steel jigs.

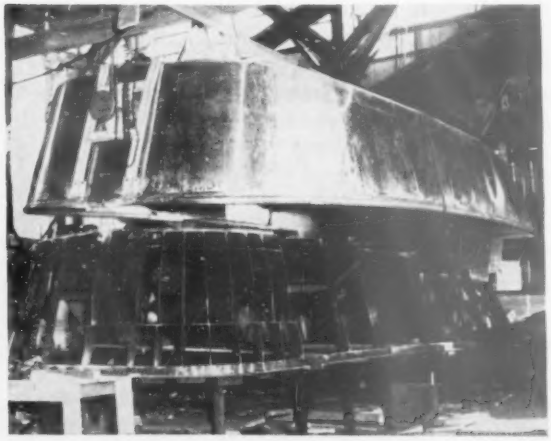
The ferryboat and fishing craft have distinct advantages:

1 — lower upkeep and maintenance costs because of aluminum's non-corrosive nature.

2 — more speed for equivalent horsepower and hull size.

Each of the gillnetters has a 10-ft 6-in. beam and is powered by a 225-hp Chrysler Imperial or 200-hp Palmer gas engine at speeds up to 23 knots.

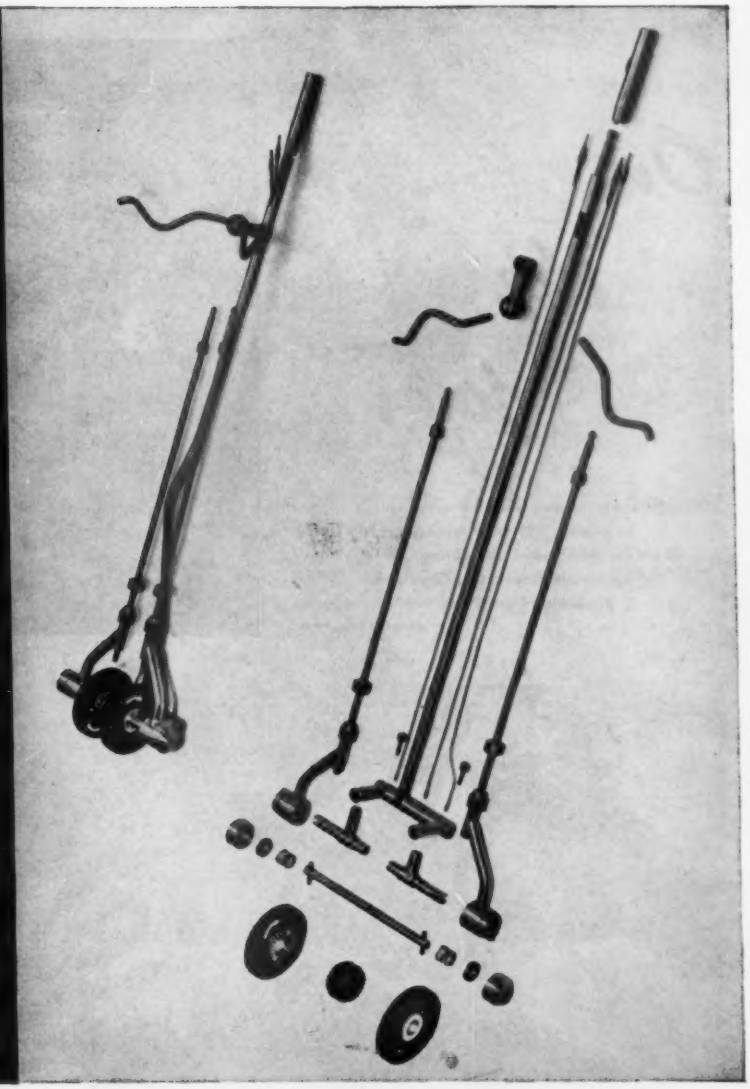
The ferryboat, powered by two GMC V-12 engines, each rated at 540 hp, will cruise at 21 knots.



ALL-WELDED gillnetter hull, left, is lifted from jig. Hull is then righted and engine and cabin installed. Lifting device welded to stern is removed when hull is righted. Semiautomatic Mig welder, below, is used to fabricate ferryboat.

HERE'S HOW STILL ANOTHER MANUFACTURER JOINS STAINLESS STEEL TUBING:

He uses Handy & Harman's BRAZE 630



He's one of many manufacturers and fabricators who have found—to their lasting satisfaction—that Handy & Harman silver alloy brazing is the final answer to stainless steel joining problems.

Super-Donic Manufacturing Company, Atlanta, Georgia, manufactures "Dual Arm Transmissions" for the dental industry. Most everybody has—at one time or another—seen and/or felt this unit in operation.

It is fabricated of small diameter 304 and 316 stainless steel tubing and, in its assembled form, consists of some 17 separate brazed joints. Joints must be strong, corrosion resistant and neat-appearing.

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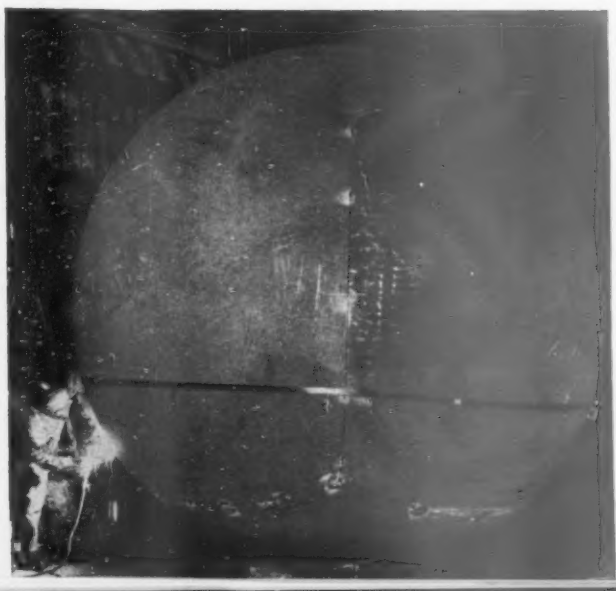
On the job . . .

SEMIAUTOMATIC vapor shielded arc welding is used to produce 229 blast furnace cooling system boxes for Hibben and Co., Chicago. Welder, made by Lincoln Electric Co., Cleveland, increased production from 5½ to over 11 completed assemblies daily.

GIANT wrought iron pump section manifold for the Deer Island sewage plant in Boston is manual metal arc welded before installation. Each of the several manifolds to be used is 89½-ft long and 11-ft in diameter. A. M. Byers Co., Pittsburgh, produced wrought iron plate ½-in.-thick for the job.



TACK-welded for fit-up prior to shipment from Lukens Steel Co., Coatesville, Pa., this giant segmental globe previews its post-fabricated form. The finished globe will be one of the largest spheres ever made from 9% nickel steel. The ½-in.-thick 123½-in. ID vessel will store liquid oxygen at 320 F below zero.

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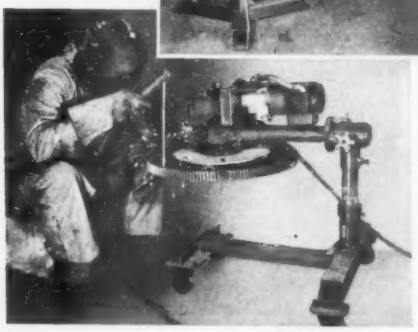

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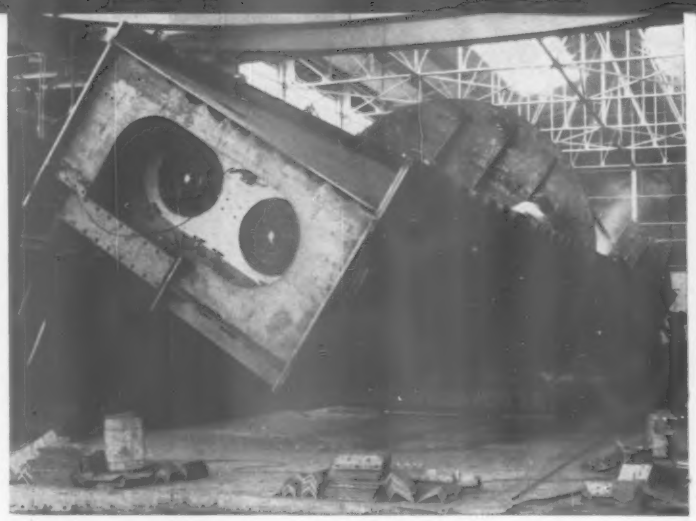


Mammoth box girder supports crane runways

AUTOMATIC WELDING and positioning helped build a 96-ton, 102-ft-long box girder recently.

The girder is the main runway support for two 100-ton cranes at a new blooming mill for Allan Wood Steel Co., Conshohocken, Pa.

Flanges are 77-in. wide, 1 3/8-in. thick on the 34-ft end sections and 1 ½-in. thick at the center section. The ¾-in.-thick, 9 ft 10 in. deep web plates are spaced 5 ft apart, while the ¾-in.-thick diaphragm plates are spaced every 6 ft along the inside.

The tack welded assembly was mounted in two 14-ft-diameter welded steel rings and then rested on powered rollers.

Thus, the girder was rotated for downhand welding, after which the rolls were turned upside down and used as a buggy to move the girder to the shipping siding.

On long seams a self-propelled submerged-arc unit deposited ¼ and 5/16-in. fillets at speeds up to 26 ipm. All fillets and butts required 100% penetration.

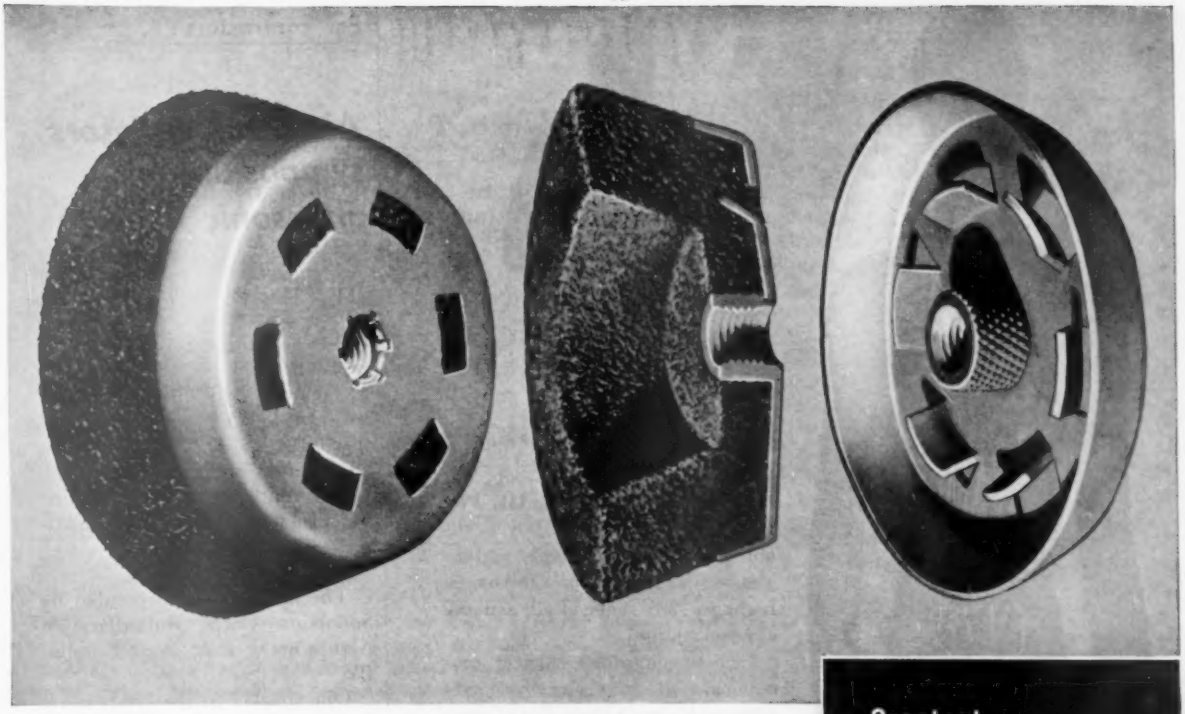
All other welding was done with E6024 and E6027 iron powder electrodes using a 500 amp a-c transformer as a power source. Welding equipment was manufactured by Lincoln Electric Co., Cleveland.

To provide adequate ventilation during welding inside seams, two exhaust fans were set in plywood panels in an end diaphragm.

Closely spaced structural tee-stiffeners were skip-welded across the bottom flange. Intermittent welds were also made around the diaphragm plates to minimize distortion effects and to reduce welding footage.

Plate stiffeners, welded to the outside of the web, were spaced about 2 ft apart and extend down from the top flange about 36 in.

Besides the main girder, some 186 other plate girders of welded design were included in the building project. These ranged from 25 to 75 ft long and weighed 7½ to 34 tons each.



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For contractors . . .

Air Force sponsors symposium on ultrasonic welding

WHAT IS ULTRASONIC welding, where is it being used and how does it fit into the nation's space program?

To answer this question for ballistic missile and space system contractors, the Air Force Systems Command, Space Systems Division, recently sponsored a meeting at its Inglewood, Calif., headquarters.

The meeting was presented by Sonobond Corp., Subsidiary of Aeroprojects, Inc., West Chester, Pa.

One speaker at the symposium, J. Koziarski of the Martin Co., Denver, pointed out two fundamental welding problems which he felt were not receiving adequate attention — problems which can be eliminated by ultrasonic welding.

The problems are:

1 — microporosity in weld zones — a result of diffusion of atmospheric gases into the molten weld metals.

2 — anisotropy — nonuniformity of properties in all directions.

Since ultrasonic welding is a solid state process, Koziarski pointed out, it can eliminate both of these.

He also discussed various other problems that could be handled by ultrasonic welding, such as joining aluminum to stainless steel for SNAP 1A nuclear-powered electrical generators.

Another speaker, Francis Becker of the Space Systems Division, stressed Russian progress in the ultrasonic welding field. He pointed out that the Russians recognize the need for ultrasonic welding on a production basis and have made surprisingly great efforts which should be considered seriously.

WE September Headlines

. . . from page 8

Vacuum chambers travel to Cleveland

GIANT welded vacuum chamber sections — too large for regular tollgate — enter Ohio Turnpike on specially constructed passageway. Fabricated at Greenville, Pa., by Chicago Bridge & Iron Co., the sections became part of a space simulation facility for the National Aeronautics and Space Administration's Lewis Research Center at the Cleveland airport.

Dallas firm obtains liquid oxygen converter

A new liquid oxygen pumping station to provide oxygen for customers has been installed at the Industrial Oxygen and Supply Co., 1010 Levee St., Dallas.

The unit, installed by the National Cylinder Gas Div., Chemetron Corp., Chicago, converts low-pressure liquid to high-pressure oxygen.

Bellows-Valvair markets Berry-Dowty pumps

Sales and service of Berry-Dowty hydraulic gear pumps and motors will be handled by the Bellows-Valvair Div. of International Basic Economy Corp., New York City.

The pumps and motors are made by Berry Hydraulics Div. of Oliver Tyrone Corp., Pittsburgh.

21 high school teachers attend welding workshop

A total of 21 industrial arts high school teachers in New Jersey have completed a summer welding workshop at Trenton State College.

The teachers spent one week in three hour evening sessions and ended with two weeks of eight hour workshop sessions.

The college presented the workshop with the cooperation of Hobart Bros. Co., Troy, Ohio, and Air Reduction Co., New York City.

Youngstown licenses B&W to make, sell steel

The Youngstown Sheet and Tube Co., Youngstown, Ohio, has licensed the Tubular Products Div. of The Babcock & Wilcox Co. to make and sell welding fittings and other products of Yoloy steel.

Yoloy is a 2% nickel 1% copper steel.

Grinding Wheel Institute issues two publications

The Grinding Wheel Institute has published two booklets which it is making available at no cost.

One booklet is entitled "American Standard Specifications for Shapes and Sizes of Diamond Grinding Wheels, Hand Hones and Mounted Wheels." This 37-page booklet can be obtained by writing to the Institute.

The second booklet, "Cause, Effect and Control," is an 81-page publication which can be obtained by writing on company letterhead to the Institute at 2130 Keith Building, Cleveland 15, Ohio.

Chicago Bridge breaks ground for new building

Chicago Bridge & Iron Co. recently broke ground for its new general office building about 20 miles west of downtown Chicago in Oak Brook, Ill.

The fully air - conditioned building will provide 75,000 sq ft of floor space in two stories and relocate 350 employees.

Lincoln holds 1-day hardfacing seminar

The Application Engineering Department of The Lincoln Electric Co., Cleveland, recently conducted a hardfacing seminar for representatives of the United States Corps of Engineers.

Ten district engineers attended the one-day program in the Cleveland plant. The program was directed to show the value and uses of hardfacing.

Handy & Harman in 1893

BARS of gold and silver are stacked on the floor in this 1893 picture of Handy & Harman. John F. Harman is at far right. The firm, which began as a bank and now produces brazing alloys, has recently moved to 850 Third Ave. in midtown New York City.

In Summary . . .

Esco Corp., Portland, Ore., and **The Bonney-Floyd Co.**, Columbus, Ohio, have been licensed by the **United States Steel Corp.** to produce and sell T-1 steel in casting form. Esco castings will often be quality checked with a betatron X-ray machine (see cut) in the firm's metallurgical lab. . .

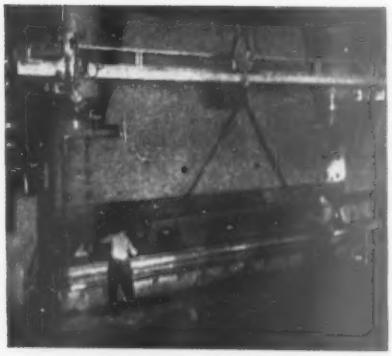
The Gevaert Co. of America, Inc. has moved its Atlanta office to 1297 Spring St., N.W. . . The new Metals Center of **E. I. DuPont De Nemours and Co., Inc.**, in Baltimore will commercially produce mill products of columbium and columbium alloys. . .

Thirty **Air Reduction Co., Inc.**, plants in the United States have been awarded certificates of safety achievement for 1960 by the Mfg. Chemists' Association, Inc., Washington, D.C. . . **Portomag Inc.** and its **Di-Cor Div.**, Ferndale, Mich., have merged with **General Automation Co.**, Detroit, to form a new company, **General Automation Mfg., Inc.** . .

Bren/Weld Corp., Brooklyn, has formed **Bren/Weld Sales, Inc.**, to handle all sales, promotion and advertising of the firm's line of welding equipment. . . **Tru-Fit Screw Products Corp.**, Cleveland, has formed a **Tru-Weld Div.** for the manufacture of shear connector studs. . .

Linde Co., New York City, has built a 140-ton-per-day on-site oxygen plant to supply **Armco Steel Corp.**'s Middletown, Ohio, facilities. . . A 20,000-kva all-aluminum power transformer is now in use at **Aluminum Co. of America**'s Massena, N.Y., works. . .

Mansfield Oxygen Co., Mansfield, Ohio, recently celebrated its 30th anniversary as a distributor. . .**Saint John Shipbuilding and Dry Dock Co., Ltd.**, St. John, New Brunswick, Canada has installed four CO_2 Mig welders purchased from **British Oxygen Canada, Ltd.** . .



A 4-million-lb pressure metal-bending machine (see cut) has been installed in the welding shop of **Harnischfeger Corp.**, Milwaukee. The machine can handle high-strength steel alloy 26-ft wide and 1¼-in. thick. . .

American Brazing Alloys Corp., Pelham, N.Y., has been awarded a contract by the U.S. Army Ordnance Corps to supply silver solder to Picatinny Arsenal in New Jersey. . .**Puritan Compressed Gas Corp.** has moved to a new building on Oak at 13th Street in Kansas City, Mo. . .

A group of Los Angeles businessmen, headed by A. M. Thompson, have formed a corporation and purchased assets of **Fabriform Metal Brazing** from the **George Getz Co.**, Chicago. Thompson is president of the new firm, known as **Fabriform Metal Brazing, Inc.** . . . **Zero Mfg. Co.**, Burbank, Calif., has formed **Zero Research Laboratories** as an operating division to handle metal joining of all types . . .

INTER CHANGE ABILITY

FOR PROTECTION-PLUS IN SOFT AND RIGID GOGGLES

Do you know you can switch retainer rings, cover plates, lenses, straps—even eyecups—throughout the Bausch & Lomb line of chippers' and welders' goggles and plate holders?

This interchangeability spells protection, economy and worker comfort. No need to retire a whole unit if a retainer ring is damaged, nor waste dollars on new lenses when new cover plates are readily available to prevent scratching and pitting. Spare parts for one B&L goggle type fit precisely all the other goggle types—soft or rigid. Sliding plates are interchangeable between chippers' and welders' plate holders making either convertible. Workers are always wearing equipment in tip-top condition, with the utmost visual and fitting comfort.

This is the Protection-*PLUS* line. Eye protection built to *last*—with parts always replaceable and interchangeable. For more information, call your supplier, or write for details, catalogs: Bausch & Lomb Incorporated, 98721 Lomb Park, Rochester 2, New York.

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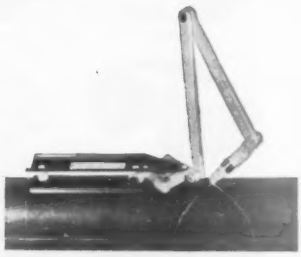
Protection PLUS Safety Products

protection + economy + worker acceptance

For more facts Circle No. 193 on Welding Info-Aid Card

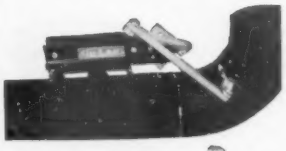
CURV-O-MARK

Contour Marker



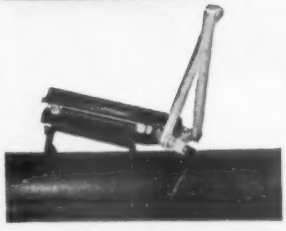
Marks off any pipe joint or structural angle cut accurately, easily and without figuring cutbacks. Contour Markers mark all around pipe — save both time and gas. Available in 2 sizes of 1½" to 18" in cross-section, 16" to 48" diameter.

Combination Adaptor



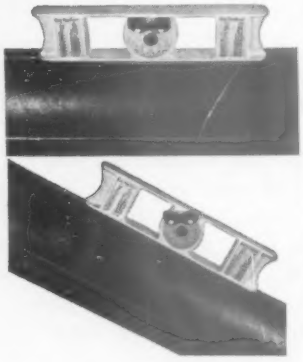
FOR CONTOUR MARKER

Adaptor allows layman to use all sides of Contour Marker in layouts on pipe and structural steel. Standard model marks up to 30" pipe, without having to quarter or halve. Marks over surface irregularities and old welds, and without having to break wrap so far back on wrapped pipe. Compound angles can be marked in one setting of tool; also, any portion of tube turns or 90°. The combination adaptor also furnished for the Jumbo Marker on special order.



Pro-Mag-Level

Pocket size and equipped with two magnets on each plane for holding level in position. One side is machined flat for flat work, and the other, to a slight V-plane for pipe. Besides level, Pro-Mag-Level is equipped with 90° dial marked in 2½° increments and scales for rise in degree per foot or meter. Frame made of strong cast aluminum.



CONTOUR SALES CORPORATION

1843 E. Compton Boulevard Compton, California

Reprints still available from WE

Reprints of certain articles published in Welding Engineer are still available. A list of these appears below. Reprints may be obtained for 15 cents each, except where otherwise noted. Payment must accompany all orders. For quantity orders, write for special prices. Order by title from: Reprint Editor, Welding Engineer Publications, Inc. Box 28, Morton Grove, Ill.

Design for welding

Basic knowledge required when designing or redesigning for welded construction is detailed and discussed. Sixteen page reprint includes 11 data sheets.

The meaning of weldability

Weldability of carbon steels and alloy steels, as well as some other metals, is discussed. Sixteen page reprint includes three data sheets.

How to weld T-1 steel

Explains how to weld this high-strength low-alloy metal. Includes a data sheet on T-1 mechanical properties.

Fundamentals of oxyacetylene welding

Gives the basic essentials on and primary steps of oxyacetylene welding.

Uses of build-up electrodes

As rebuilding and reclaiming of worn steel parts becomes standard maintenance procedure, build-up electrodes increase in importance. This 2-page reprint lists the qualities necessary for a good build-up material.

A guide to preheat

This 4-page reprint on benefits of preheat includes an engineering data sheet entitled "Recommended preheat for steel alloys."

Acetylene

A 12 page salute to the IAA and acetylene, details the great success of this gas. Includes a history of the IAA and "The Acetylene Journal."

Filler metals for brazing

Brazing filler metals are detailed and each group is analyzed. Includes data sheet on how to select silver brazing alloys.

Explosive welding and forming open another door

A report on one of the newest entries into the welding industry, and how one pioneer company turned theories and practices into realities.

Our modern-day mythology

A rebuttal to some old-wives tales about the hazards of welding fumes, plus safety recommendations for situations where hazards might develop.

Welding the reactive metals

This 12-page reprint describes techniques for Tig welding titanium, zirconium and tantalum. It also gives experimental data on resistance spot welding of tantalum.

Welding 17-4 PH stainless steel

Sound joints can be easily produced in 17-4 PH stainless by proper welding practice. This 4-page reprint details all phases of the procedure.

Non-destructive testing

Four separate articles comprise this 8-page reprint on non-destructive testing: how to interpret radiographs; circumstances and job requirements govern selection of radiation source in inspection; ultrasonic testing; and a program for radiation safety.

Reprints Available

Welding thoriated magnesium

Development of specialized machinery and techniques for joining new magnesium alloys, especially thoriated types, has aided in the production welding of such materials. This 4-page reprint includes tables on mechanical properties and on weld defects and how they affect weld strength.

Instructions for welding moly

Molybdenum has a melting point of 4,730 F, which makes it ideal for high-temperature service in planes, missiles and nuclear reactors. This report gives welding data resulting from six years of experimental work sponsored by the Office of Naval Research. This reprint free.

Effect of arsenic on welds

A study of arsenic's effects on the mechanical properties of welds in mild steel was directed specifically toward a determination of arsenic's role in behavior of welding fittings. Results are revealed in this 4-page reprint.

Stress relieving

Stress relieving can be an important manufacturing operation or a needless expense item. This 4-page reprint is intended to help you in making a correct decision in the matter.

Techniques for torch brazing aluminum

Procedures and techniques for brazing aluminum, are detailed. Includes data sheet on brazability of aluminum alloys plus four tables listing commercial products and their characteristics. This reprint is free.

Fixtures for brazing

Presents requirements for designing brazing fixtures and materials to be used. Data sheet on properties of non-metallic fixture materials included. Free.

New aluminum alloy not prone to brittle fracture

Extensive testing of 5083 aluminum alloy proves it has excellent weldability and weld ductility, and a good resistance to corrosion and stress concentration. Testing for brittleness is detailed. This reprint is free.

Determining strength of fillet welds on angles

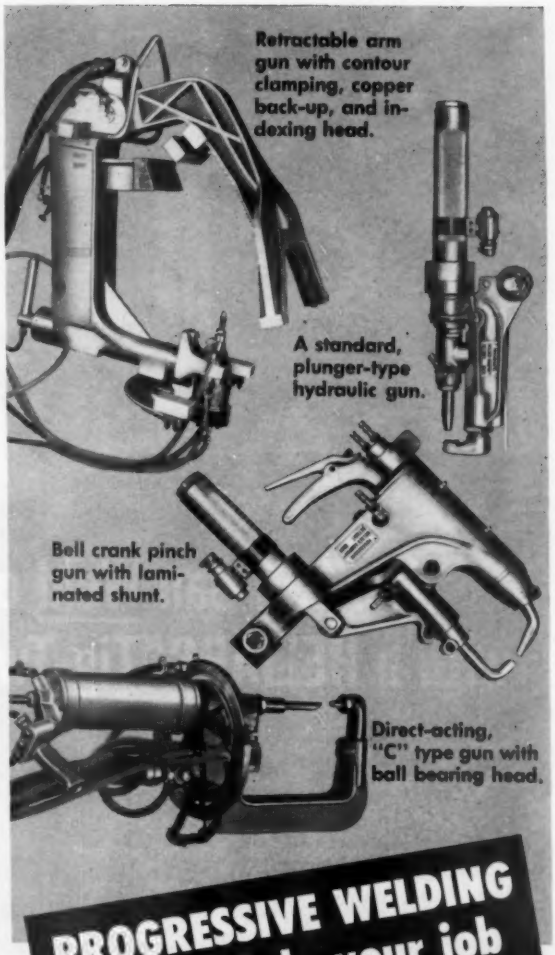
This 4-page reprint gives the method of determining the correct weld size and length for the most economical strength, joint efficiency, and margin of safety.

How to simplify machine bracket design

This reprint explains the welding advantages of machine bracket design, including diagrams with explanations.

How to get better stainless steel welds

4 page reprint explains the procedures for better stainless welds giving certain basic fundamentals that will spell the difference between success and failure on a job.


Retractable arm gun with contour clamping, copper back-up, and indexing head.
A standard, plunger-type hydraulic gun.
Bell crank pinch gun with laminated shunt.
Direct-acting, "C" type gun with ball bearing head.

PROGRESSIVE WELDING GUNS will do your job BETTER, for LONGER!

Standard or special built, mammoth or midget, there are more Progressive Welding Guns used today than all others combined—the reason is quality at lowest possible cost.

Progressive's portable guns are engineered for top efficiency and dependability, built of quality materials for longer service life and comprised of standard, interchangeable parts for greatest economy.

Special or standard, there is a Progressive Welding Gun for your job. Your inquiries are invited.

PROGRESSIVE WELDER & MACHINE CO.
915 Oakland, Pontiac, Mich.

For more facts Circle No. 196 on Welding Info-Aid Card

Now You Can Weld or Cut with a HELIARC "Tig-Twin" Kit...

When you own one of the new LINDE·Heliarc "Tig-Twin" Kits, you're ready to take on almost any inert-gas-shielded arc welding or cutting job!

Use the lightweight torch for Heliarc welding. It's the fast, convenient method of joining ferrous and non-ferrous metals without flux. Then use the same torch to cut light-gage metals—without additional attachments.

Heliarc "Tig-Twin" Kits contain standard, high-quality LINDE components. They're designed to perform economically through years of trouble-free service. And the price is right. Talk to your nearby LINDE distributor now. Or write for his address to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY

UNION CARBIDE

LINDE, HELIARC and UNION CARBIDE are registered trade-marks of Union Carbide Corporation.

VIPS in review...

Richard C. Kanak has been appointed Chicago - Milwaukee area territory manager for Smith Welding Equipment Div. of Tescon Corp., Minneapolis.

Kanak

Bichsel

Harry J. Bichsel has been named manager of the Westing-Arc Department of the Westinghouse Electric Corp., Buffalo. Bichsel was formerly engineering manager of the department, and most recently was assistant to the vice president in charge of the General Products Group of Westinghouse Divisions. He replaces **Richard C. Lipps** who has resigned.

The Bastian-Blessing Co., Chicago, has appointed **Joseph Koss** as assistant works manager and named **Ronald F. Remley** assistant advertising manager of The Reg O division. Koss has been production manager for the firm since 1943.

Koss

Tomlinson

Alloy Rods Co., York, Pa., has appointed **Ralph L. Tomlinson, Jr.**, as sales representative in the greater Los Angeles area. Tomlinson will operate from the company's El Segundo office.

Circle No. 197 on Welding Info-Aid Card

product defects

getting you down?

let us help you . . .

✓ ***find hidden cracks***
with magnetic particle or dye penetrant inspection equipment

✓ ***find deep-lying defects***
with x-ray or gamma radiography equipment

✓ ***see "innards" directly***
with bright-image fluoroscopes

✓ ***work out the method***
at our Industrial Applications Lab

call any local Picker office
where a technical expert is always near (see 'phone book) or write

Picker x-ray

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QUIK-HEAT

up to 2200° F.

CLEMENTS

Cadillac

MODELS K3 & M2

BLOWTORCHES

Here are rugged, high efficiency blowtorches that speed up all types of heat treating and production operations. These two Clements Cadillac Blowtorches provide heat up to 2200°F. in seconds and are fully portable.

With the Clements Cadillac model K3 or M2 you can bring the torch to the work instead of the work to the torch as in fixed installations. Furnished fully equipped with 20 ft. of Underwriters' Laboratories and Canadian Standards Association approved 3-wire cable with plug, 10 ft. of gas hose with fittings ready to attach to your gas line and with sturdy, high stability stand. Easily adjustable for height and direction of torch.

Operates on natural, manufactured, or LP-gas.

CLEMENTS MFG. CO.
6645 S. Narragansett Ave., Chicago 38, Ill.
SINCE 1910
INDUSTRIAL PRODUCTS DIVISION

Circle No. 198 on Welding Info-Aid Card

Tec Torch Co., Inc., East Rutherford, N.J., has appointed **Leon A. Micheline** as sales manager and **Raymond J. Wallace** Western regional sales representative. Wallace will operate out of Los Angeles.

Teeple

Bronco

Ralph J. Teeple has been appointed sales manager and **T. P. Bronco** has been appointed district sales manager for the New York district of Page Steel and Wire Division of American Chain & Cable Co., Inc., New York City.

George M. Burrier has been named assistant general manager in charge of primary production at the Indiana Harbor Works of Inland Steel Co. Burrier was formerly works manager of the Crucible Steel Co.'s Midland, Pa., works.

Frank H. Turbyville, Jr., has been named plant manager for the new Lockeford, Calif., plant of Graver Tank & Mfg. Co., Chicago.

Mike W. Eddins has joined National Valve and Mfg. Co., Pittsburgh, as welding engineer in charge of all welding operations.

The Emerson Electric Mfg. Co., St. Louis, has appointed **Val J. Henning** comptroller and assistant secretary. He succeeds **Byron W. Jackson** who has left the firm.

A. Frederick Nielsen, sales manager of welding cable, engineering and services of Phelps Dodge Copper Products Corp., New York City, has been elected president of The Adventurers' Club of New York, Inc.

Roy Poe, former Midwest district manager for WELDING ENGINEER, has been appointed sales manager of Lenco, Inc., Jackson, Mo.

—your LINDE distributor!

Time is money, and your LINDE distributor is the man to save you a lot of both. He maintains complete stocks of equipment. They're top in quality—the LINDE brand name is your assurance of that. Whether it's for welding and cutting apparatus, industrial gases, welding rods, supplies, or accessories—you can count on your LINDE distributor to deliver what you want *fast*.

What's more, he can back up this service with sound, knowledgeable advice on welding and cutting. He's a welding supply specialist, an independent local businessman—*it's his business to know your business.* And for extraordinary problems, he can draw on LINDE's exceptional technological services which have been built on more than 50 years of pioneering in welding.

A phone call from you is all it takes to enlist his services. Look up your LINDE distributor in the classified directory, or write for his address to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada,* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

Your LINDE Distributor

"Where One Call Gets It All"

LINDE COMPANY UNION CARBIDE

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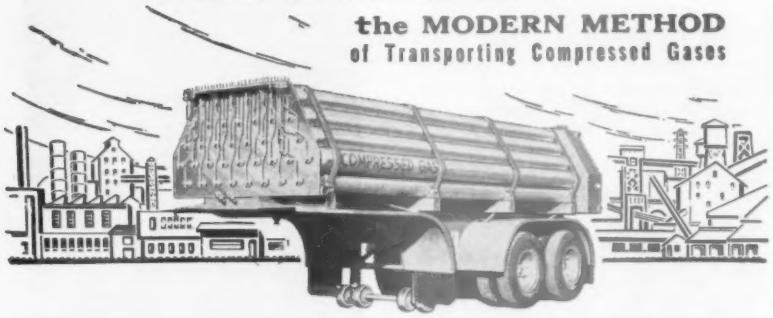
the MODERN METHOD
of Transporting Compressed Gases



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tailored just for YOU

- MANIFOLD & CONTROLS — for YOUR Gas and Handling Requirements
- CAPACITY — to meet YOUR Requirements
- SAFETY — Cylinders, Safety Devices, Controls etc., All in accordance with ICC Requirements for YOUR Protection.
- CHASSIS — by leading Chassis Manufacturers with Service Branches throughout the United States for YOUR Convenience.

SEND YOUR INQUIRIES TODAY TO

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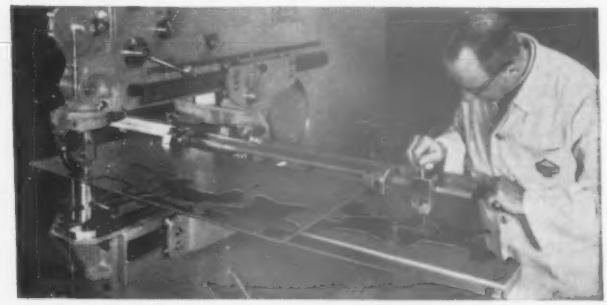
CONSULTING IECO DESIGNING RESEARCH
Manufacturers of
CYLINDERS AND GAS PRODUCING EQUIPMENT
ACETYLENE · OXYGEN · NITROGEN · ARGON
O'FALLON 5, ILLINOIS

TRUMPF

"COPY NIBBLERS"
mass produce any shape
...Copy directly from your master

Quickly—
Easily—
Economically
does

- Beading
- Folding
- Shearing
- Slotting
- Flanging
- Louver Cutting



Eliminate high tooling costs:
Sheetmetal is firmly clamped and guided by roller-bearing coordinates as operator effortlessly feeds tracer along template contours. Built-in rulers quickly position sheet for rectangular cuts. Circular cuts to 24" diameter are made through a special swivel ruler.

All-side-cutting punch pierces its own starting hole—cuts in any direction without distortion. Copy nibbles up to 9 gage steel—regular nibbling up to 0.20" steel—shears up to ¼" steel.

Steplessly adjustable stroke and stroke position. Three models—throat depths 41", 49" and 59". Universal forming attachments available.

Demonstrations arranged with Factory Specialists.

COSA
Importers of Leading Precision Machine Tools
Nationwide Sales and Service
COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

James G. Duggan has been elected secretary and treasurer of Fansteel Metallurgical Corp., North Chicago, Ill. He succeeds **John S. Jaronik** who retires after 31 years of service with the company.

Allis- Chalmers Mfg. Co., Milwaukee has made four top-level personnel changes. **H. W. Cory** has been appointed assistant general manager and **Dwight H. Lory** has been named assistant works manager of the Norwood, Ohio, works. **L. J. Frick** has been named Midwest manager of the Industrial Equipment Division and **Leonard J. Linde** has been appointed director of engineering for the firm's Industries Group.

Merle J. Davis has been appointed sales manager of Anchor Alloys, Inc., Brooklyn. Davis was formerly manufacturing manager for International Rectifier Corp., El Segundo, Calif.

All-State Welding Alloys Co., Inc., White Plains, N.Y., has appointed **Robert FitzSimons** publicity manager and **LeRoy Wymss** comptroller.

William Mugan has been appointed general manager for Labeled Metal Products Co., Chicago, a division of Howe Sound Co.

Elmer R. Dysert has been appointed superintendent of the Marietta, Ohio, pipe fabrication shop of Dravo Corp., Pittsburgh.

Dysert

Reuter

Eutectic Welding Alloys Corp., Flushing, N.Y., has named **Matt L. Stano** district manager for Southeastern Wisconsin, and **John W. Reuter** division manager of eleven western states, Alaska and Hawaii.

Linde Co., New York City, has appointed Dr. **Milton Stern** manager of research of the Speedway, Ind., research laboratories.

At Independent Engineering Co., O'Fallon, Ill., the following changes have taken place. **Pierce Marks, Jr.**, is now president. **Ray Christopher** is vice president in charge of engineering; **Ray Richards** is vice president in charge of production. **Mike Coyne** and **L. W. Fleischer** are directors and vice presidents of Independent which has recently been acquired by American Cryogenics, Inc.

Gim H. Lee, former production manager of tungsten and molybdenum for the Wah Chang Corp., has been appointed vice president in charge of operations for Metallurgical International, Inc., Wallington, N.J.

Clarke

Fitzpatrick

K. C. Clarke has been appointed a vice-president of Shawinigan Products Corp., New York City. Replacing Clarke as export sales manager of Shawinigan Chemicals Ltd., Montreal, is **L. F. Fitzpatrick**

Jack P. Kennedy is the new sales manager of Wayne Welding Supply Co., Inc., Fort Wayne, Ind. Kennedy was formerly Midwestern district sales manager for the welding products division of Westinghouse Corp.

Thomas E. Moon, an engineer stricken by blindness who developed a cornea transplating machine, has been named recipient of the 1961 Holley Medal of The American Society of Mechanical Engineers. Moon has also designed an improved electrical soldering gun.

James McWhirter, general manager of Industrial Chemicals Div., Pennsalt Chemicals Corp., Philadelphia, has been elected a vice president of the company.

Norman A. Matthews has been appointed group leader for ferrous metallurgy at the Bayone, N.J., research laboratory of the International Nickel Co., Inc.

For more facts Circle No. 201 on Welding Info-Aid Card

STEELARC
CUTTING ELECTRODE
CHAMFER ROD

the versatile electrodes for field work to JOIN · CUT · SHAPE

Used extensively in construction • road building • farming mining • job shops • maintenance work

STEELARC® is All-State's specially coated electrode for all mild steel work —flat, vertical, overhead positions. Pass on pass without slag removal. AC or DC. One rod inventory.

All-State CUTTING ELECTRODE for fast, economical arc cutting of steel, cast iron, stainless, high chrome armor plate. AC or DC.

All-State CHAMFER ROD for chamfering, gouging, bevelling, routing and channeling without oxygen or air. Made with special compounded flux coating to protect rod and speed work. AC or DC.

High speed Cutting Electrode slices through cast iron machine housing. This one low-cost electrode cuts any ferrous alloy, lowers inventories.

Economical • Practical • Versatile • Distributors everywhere.

Send for a free copy of our 56-page Manual and Catalog.

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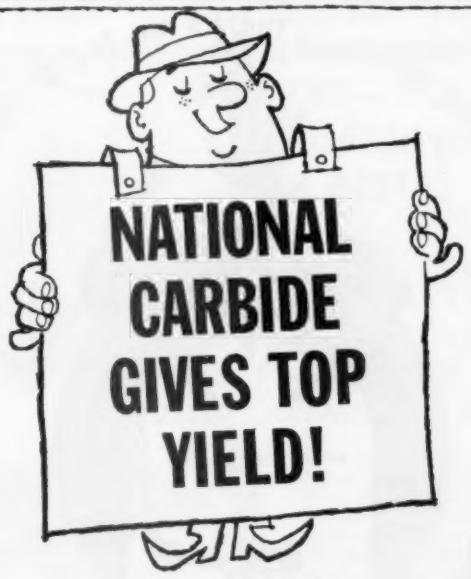
White Plains, N.Y. Dial 914 WH 8-4646
QUALITY WITH SERVICE



All you want—when you want it in the **RED DRUM.**
All sizes, in quantities from 2 lb. pkgs. to 5 ton hoppers.

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For more facts Circle No. 203 on Welding Info-Aid Card

BECKER

HAS IT...OR CAN MAKE IT—

if it's CARBON or GRAPHITE!

A dependable source for everything in Carbon and Graphite

Graphite Cores and Chills—Graphite Powder and Particles of any mesh . . . complete Graphite Fabrication Facilities.

BRUSHES . . . for all motor and generator applications . . . carbon, graphite, copper leaf, gauze and metal-graphite.

WELDING ELECTRODES, WELDER BRUSHES . . . Keen-Cut Electrodes for carbon arc-air jet cutting . . . Keen-Arc Carbons, cored and heavily copper coated, for twin-arc torches . . . paste, rods and plates.

EXTRUSIONS, MOLDED SHAPES OR SPECIAL CARBONS designed and produced to your specifications.

COMPLETE BECKER ENGINEERING SERVICE
is always available and entails no obligation whatever

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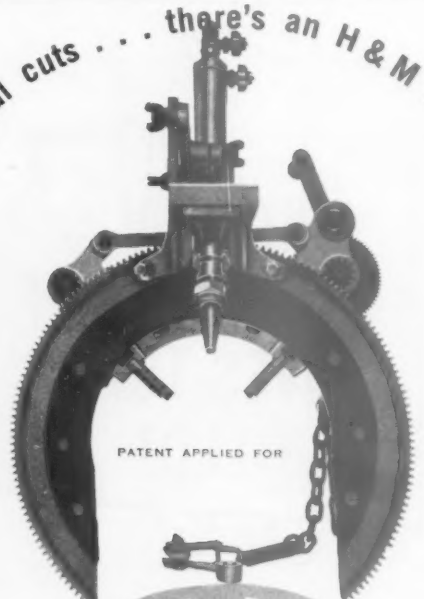

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F. Kenneth Iverson has been appointed executive vice president of Coast Metals, Inc., Little Ferry, N. J. Iverson was previously sales manager for Cannon-Muskegon Corp.

Iverson

Crouch

John C. Crouch has been elected vice president of The McKay Co., Pittsburgh. Crouch will continue as assistant secretary of the firm but will now devote himself primarily to personnel and public relations.

Inland Steel Co., Chicago, has made a series of management personnel changes. **Robert S. Gentz** has been appointed general manager of the Indiana Harbor works. **Michael Tenenbaum** has been named general manager of research and quality control, and **James J. Halley** has been named manager of research and development.

DIED . . .

A. J. Fisher, Jr., 47, executive vice president of Metal & Thermit Corp., Rahway, N. J., died last month in Norwalk, Conn. Mr. Fisher joined the firm in 1955 as a member of the market research department and was elected vice president last year. He is survived by his widow, a son, a daughter and his father.

S. M. Stoody, vice president and co-founder of the Stoody Co. Whittier, Calif., died in a crash of his airplane recently while flying near his ranch at Chino, Calif. As oil field weldors, Mr. Stoody and his brother, William F. Stoody, pioneered the development of hardfacing and as a result established a broader use for welding.

Book reviews...

Steel for missiles

HIGH-STRENGTH STEELS FOR THE MISSILE INDUSTRY. Published by the American Society for Metals, Metals Park, Ohio. Edited by H. T. Sumsion, 1961, 276 pages. Price $12 ($14 outside of U. S. & Canada)

Problems in development and application of ultra-high-strength metals for the missile program are stressed in this fully-illustrated technical book for engineers.

The book by 14 authors is composed of papers presented at the symposium on the subject during the Golden Gate Metals Conference in San Francisco last year.

Pyrometer readings

CORRECTED OPTICAL PYROMETER READINGS. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. By D. E. Poland, J. W. Green, and J. L. Margrave. 1961, 74 pages. Price 55¢.

This table enables optical pyrometer users to immediately convert the observed temperature to the true temperature, taking the effective emissivity into consideration if the true temperature is known by comparing this temperature with the pyrometer reading.

The table gives observed temperatures from 1,000 to 3,000 K in increments of 50 degrees and from 10,000 to 39,900 K in increments of 100 degrees.

Metallurgical information

GUIDE TO METALLURGICAL INFORMATION: SLA BIBLOGRAPHY No. 3. Special Libraries Association, 31 E. 10th St., New York 3, N. Y. Heavy-paper bound, 96 pages. Edited by Elizabeth W. Tapia. Price $4.

This bibliography describes more than 600 books, journals and other information sources in the field of metallurgy. Updating Richard Rimbach's *How to Find Metallurgical Information,* published in 1936 and long out of print, the coverage has been extended to include societies, trade associations, research institutes,

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The Navy didn't believe, tested it 3384 hours in salt spray (100 hours is normal), then approved it. Westinghouse reports Galv-Weld roof sign, installed 1936 — still perfect in 1959 — 23 YEARS LATER!

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Regalvanizes corrosive seams and areas where galvanizing is burned away by welding, skipped in hot dip galvanizing, or abraded in fabrication.

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government agencies and technical services.

The scope is world-wide and reference sources published in the past 20 years are emphasized though some older material is included.

Consulting engineers

THE CONSULTING ENGINEER. Published by John Wiley & Sons, Inc., 404 Park Ave. South, New York 16, N. Y. By C. Maxwell Stanley. Price $5.95.

The ultimate goal of the consulting engineer, according to this book, is better engineering for the client, but en route the engineer must also cope with management and professional problems. The book is devoted exclusively to these aspects of a consultant's practice.

The author explores the consulting engineer's professional relationship to his client, to other companies and to the public. He then plunges into the internal problems of a consulting practice, discussing organization and management.

Radiation hazards

PEACETIME RADIATION HAZARDS IN THE FIRE SERVICE. Published by the Trade and Industrial Branch, Div. of Vocational Education, U. S. Office of Education, Washington, D. C. Price: Student manual 30¢; Instructor's manual (42 pages) 35¢.

Two new instruction programs help firemen learn how to cope with radiation hazards in fighting fires.

The 4-hr orientation unit consists of an instructor's guide, a student manual and 12 illustrative charts. The unit is intended for presentation to large numbers of professional and volunteer firemen. A 15-hr basic course will be published in the near future.

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Personnel Office, Dept. WE

135 South LaSalle Street, Chicago 3, Ill.

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DIVISION OF GENERAL DYNAMICS

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The man we are seeking must have 7-15 years broad experience handling diversified line of hard surfacing materials and be thoroughly familiar with their specific applications. He must also have the ability to demonstrate our products.

Remuneration will be on a salary + commission basis.

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Salesman — 10 years experience in all phases of gas and electric welding. Residence Los Angeles area desired. Familiar western markets. B.S. degree. Will travel. Age 35. Resume on request. Write Box No. 918, c/o Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

HELP WANTED

Immediate openings for regional salesmanagers in Indiana, Ohio, Illinois and Michigan. Must have background in flame cutting, mathematical capacity and preferably experience in selling and administration. To manage sales of Dow Chemical Company's MAPP gas. An opportunity to get in on the ground floor for a revolutionary new product. Send a personal summary to Thermal Concentrates, Inc., 311 Columbus Avenue, Bay City, Michigan.

MANUFACTURERS AGENT: Contacting welding supply distributors. Progressive, rapidly growing Brazing Alloy manufacturer. Most areas open. Write: American Brazing Alloys Corp., Pelham, N. Y.

Manufacturer's Representatives to call on welding distributors and welding supply houses for manufacturer of CR 39 all-plastic welding cover lenses. Territories available in East, West, and Midwest. This is an opportunity to add a profitable line of a quality repeat product with little extra cost or effort. Write Box 919, c/o Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

SALES REPRESENTATIVES

Young aggressive organization would like to engage representatives to call on welding supply dealers in the following territories:

South — Southwest
Midwest — West Coast

PRODUCTS: Stainless Steel Electrodes, Manganese Electrodes, Bare & Coated Stainless & Aluminum Spooled & Cut Wire. Excellent Commissions — Send Complete Resume of Qualifications & Territory Desired to Box No. 917, c/o Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

VESSEL ENGINEER

Experienced in design and manufacture of vessels and process equipment by East coast manufacturer. Chemical or mechanical engineering education desirable. Must know ASME Code work. Knowledge of carbon steel, stainless steel, aluminum and alloy fabrication, machining and welding of all types required. Unusual opportunity — excellent salary. Send complete resume to Box 920, c/o Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

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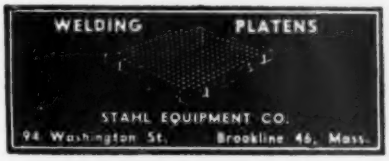

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EQUIPMENT FOR SALE

For Sale — 2,000# — 1/8 x 14 P&H (Harnischfeger) Washcoat (Type E4510) Electrodes in original packages, price $.10 per lb. F.O.B. Indianapolis. Call or write:

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LITERATURE for your library

AUTOMATIC ARC WELDING — Hobart Bros. Co. Profusely-illustrated 66-page booklet (EW-266) contains information on a wide variety of automatic and semiautomatic arc welding equipment.
Circle No. 76 on Info-Aid Card.

STEEL DESIGN — U.S. Steel Corp. Four papers are included in this 59-page brochure which describes new concepts in steel design and engineering including illustrations and descriptions of actual designs.
Circle No. 77 on Info-Aid Card.

COMBUSTION INDICATOR — Selas Corp. of America. Bulletin Q-2 is 8-page illustrated description of a combustion indicator which shows changes in flame characteristics caused by variations in air/gas mixture.
Circle No. 78 on Info-Aid Card.

HOLE PUNCHING — Wales Strippit Inc. Catalog BN, 12 pages, tells how to choose correct sheet metal hole punchers and gives hints on mounting and short cuts.
Circle No. 79 on Info-Aid Card.

PRESSURE BLASTING — Norton Co. Twelve-page report on pressure blasting emphasizes proper selection and use of aluminum oxide and silicon carbide abrasives.
Circle No. 80 on Info-Aid Card.

WIRE, CABLE — Hatfield Wire & Cable Div. Twenty-eight page fully-illustrated booklet includes information on facilities, product line, distribution and method of producing cable.
Circle No. 81 on Info-Aid Card.

WELDED STEEL TUBING — Revere Copper and Brass Inc. Four-page brochure describes the production and testing of resistance welded steel pressure tubing.
Circle No. 82 on Info-Aid Card.

OVERLAYING DISSIMILAR METALS — Air Reduction Sales Co. Form ADR 132 is a fully-illustrated article on new methods of overlaying dissimilar materials with the gas shielded processes.
Circle No. 83 on Info-Aid Card.

CUTTING TORCH — Linde Co. F-1395A is a 2-color illustrated sheet on natural gas cutting torch that can cut 30-in. of metal in one pass.
Circle No. 84 on Info-Aid Card.

ALUMINUM CLAMPS — United Associates. Two-color four-page catalog describes a new line of high-tensile-strength aluminum threadless-spindle clamps.
Circle No. 85 on Info-Aid Card.

HARDFACING ALLOYS — American Manganese Steel Div. Specifications. prices and illustrations are included in this 16-page price list (No. 35) of various hardfacing alloys.
Circle No. 86 on Info-Aid Card.

MOTOR CONTROL — Sciaky Bros., Inc. Four-page Bulletin No. 343 is detailed discussion of a motor control for turning d-c motors into accurately controlled servo-mechanisms.
Circle No. 87 on Info-Aid Card.

BACKING RINGS — Robvon Backing Ring Co. Illustrated sheet gives the proper welding procedure for using Type C backing rings.
Circle No. 88 on Info-Aid Card.

TORCH BRAZING — Engelhard Industries, Inc. Data File details procedures for torch brazing with low-temperature silver brazing alloys. The file describes six steps for leak-proof joints.
Circle No. 89 on Info-Aid Card.

ELECTRODE STABILIZER — W Corp. Form ADV-1, 4 pages and full color, gives information on a welding electrode moisture stablizer.
Circle No. 90 on Info-Aid Card.

ABRASIVE WHEELS — Merit Products, Inc. Technical Data Sheet No. FD-30 discusses features and applications of an abrasive cloth wheel for simplifying sanding and polishing of complex contoured surfaces. Grit grades and prices are included.
Circle No. 91 on Info-Aid Card.

PREHEATING STEEL — J. B. Nottingham & Co. Form SH102B is a 4-page guide, complete with chart, on practical preheat for welding high performance steels with strip heater systems.
Circle No. 92 on Info-Aid Card.

OXYACETYLENE WELDING — Modern Engineering Co. Catalog No. 170 is a 24-page illustrated pocket catalog of oxyacetylene welding and cutting equipment and allied soldering-brazing equipment.
Circle No. 93 on Info-Aid Card.

BRAZING ALLOY — Wall Colmonoy Corp. Two-page data sheet (No. 2.2.1) describes product for brazing alloy flow control and lists application procedure, removal procedure and recommended uses.
Circle No. 94 on Info-Aid Card.

D-C ARC WELDERS — The Lincoln Electric Co. Bulletin No. 4609.1 describes performance features and construction details of a new line of three-phase rectifier d-c arc welders.
Circle No. 95 on Info-Aid Card.

ABRASIVE PRODUCTS — The Carborundum Co. Catalog (Form No. A-1555) is 50-page listing of standard coated abrasive products for various industrial uses.
Circle No. 96 on Info-Aid Card.

TESTING MACHINES — Steel City Testing Machines, Inc. Bulletin G-361, 4 pages and 2 colors, describes various testing machines including brinell hardness testers, pentrascopes, ductility testers and tensile testers.
Circle No. 97 on Info-Aid Card.

CABLE CONNECTORS — Tweco Products, Inc. Form No. 124-BP is a 2-page sheet describing cable connectors with ball-point cable connection.
Circle No. 98 on Info-Aid Card.

PROTECTIVE CLOTHING — Safety Clothing and Equipment Co. Four-page illustrated Catalog W-54 lists gloves, mittens, aprons, overalls, jackets, sleeves, curtains and other clothing for weldors.
Circle No. 99 on Info-Aid Card.

INERT GAS WELDING — K-G Equipment Co., Inc. Four page price list includes inert gas arc welding torches, accessories, tungsten electrodes.
Circle No. 100 on Info-Aid Card.

SAFETY HATS, CAPS — Flood Safety Products Co. Bulletin No. 18 is illustrated 4-page catalog of various safety hats and caps with a suspension design.
Circle No. 101 on Info-Aid Card.

FLUXES — The Superior Flux & Mfg. Co. Catalog 258 lists prices, data on line of fluxes for welding brazing and soldering of all metals.
Circle No. 102 on Info-Aid Card.

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NEW PRODUCTS on pages 24-35

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Advertisers' Literature

Literature offered in advertisements which were received up to the 5th of last month. To get the literature you want circle numbers on fold-out card at right.

201. All-State Welding Alloys Co., Inc. — Catalog and Manual available on "Steelarc" cutting electrodes and chamfer rods.

164. Ampco Metal, Inc. — Bulletin RW-10 gives complete information on making welding dies of all types, flash-butt, projection and cross-wire.

211. Anaconda American Brass Co. — Publication B-3 describes modern procedures for welding using Anaconda welding rod alloys.

190. Aronson Machine Co., Inc. — Write for detailed engineering data on Aronson positioners.

203. Becker Brothers Carbon Co. — Catalog available on Beckers welding electrodes, carbon and graphite and other materials used in welding.

154. Bernard Welding Equipment Co. — Booklet available, "The use of Water Cooling for Welding Equipment" explains the use and methods of water cooling for all types of welding equipment.

161. Bridgeport Brass Co. — Information on Bridgeport welding rod is available in a booklet, "Bronze Welding."

174. Cam-Lok Div. — Catalog available on complete line of Connectors, Plugs and Receptacles.

176. Electric Arc, Inc. — Illustrated brochure on stress relieving weldments available.

172. Fibre-Metal Products Co. — Bulletin No. T2-R is available on "SuperGrip" ground clamps.

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212. H & M Pipe Beveling Machine Co. — Send for latest catalog and price list of H & M products.

189. Handy & Harman — "Easy-Flo and Sil-Fos" is a bulletin on silver brazing and its benefits including production techniques.

151. Hobart Brothers Co. — Data Sheet AU-1406-E available on the new Hobart Rectifier with automatic wire feed.

155. International Nickel Co., Inc. — Descriptive bulletin available on Welding of nickel-chromium iron alloy.

191. Manhattan Rubber Div.—Bulletin 7157 available on heavy duty abrasive wheels including the safety back flared cup.

157. Merrill Brothers — Catalog C-3 further explains the "Adjusta Clamp" and other material handling devices.

167. Metco Inc. — Bulletin available on flame spraying, "Metco Thermo-Spray."

171. Oxo Welding Equipment Co. — Catalog available on Oxo Fittings and other products manufactured by Oxo.

162. Page Steel and Wire Div. — Information on the complete line of Page welding wire is available in Folders DH-402 and DH-1218.

186. Riegel Textile Corp. — A glove guide is available giving information on styles, types, materials and chemical resistance of weldor's gloves manufactured by Riegel.

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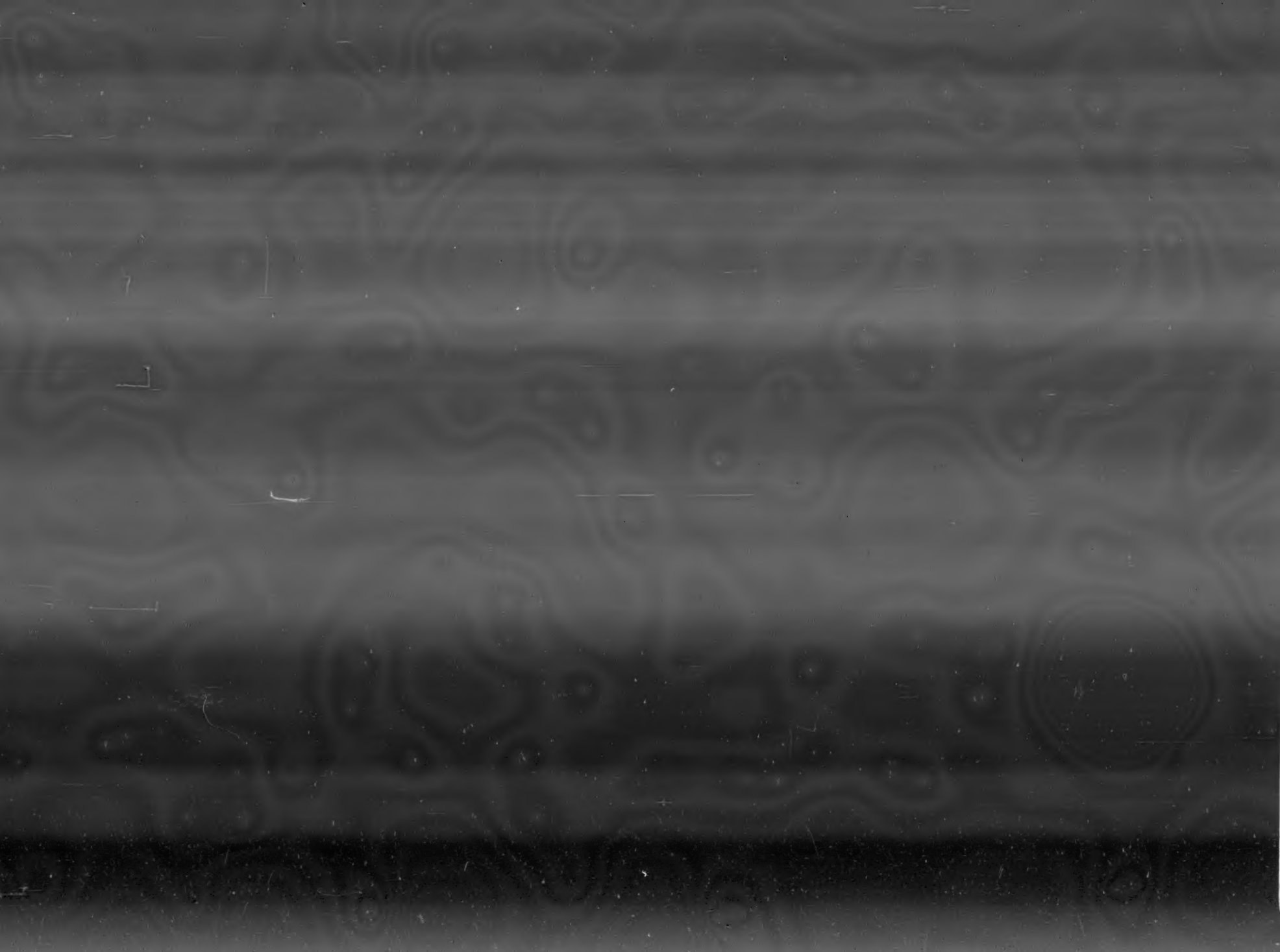

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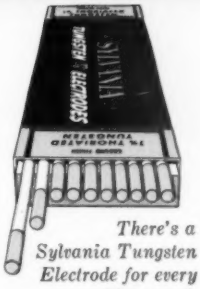

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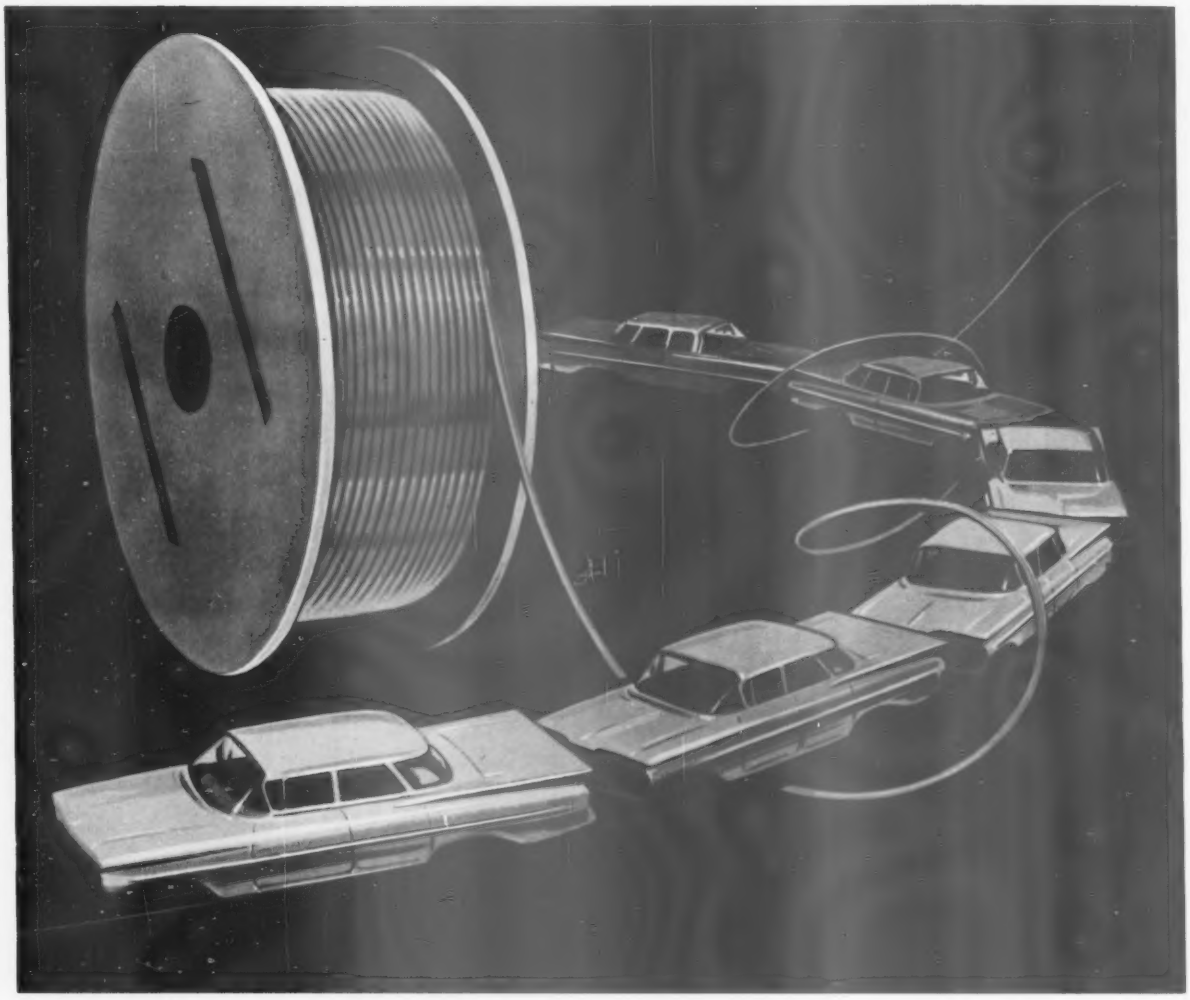

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